

# INDIAN TEA ASSOCIATION.

SCIENTIFIC DEPARTMENT

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TOCKLAI EXPERIMENTAL STATION

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ANNUAL REPORT - 1952.

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|-----------------|-----|------------------------------------------------------|
| G. M. Das       | ... | Senior Entomologist                                  |
| K. C. Sarmah    | ... | Actg. Mycologist                                     |
| J. M. Trinick   | ... | Tea Taster                                           |
| I. McTear       | ... | Resident Engineer                                    |
| P. M. Glover    | ... | Senior Advisory Officer, Assam Valley and North Bank |
| R. I. Macalpine | ... | Senior Advisory Officer, West Bengal                 |
| A. D. Swan      | ... | Advisory Officer, Cachar                             |
| C. D. Heath     | ... | Advisory Officer (in United Kingdom)                 |

### **Buildings :**

The Resident Engineer's bungalow was completed and taken over on 28th November. Work on the dismantling of the 'Bara' Bungalow and its replacement by two smaller bungalows started in December. The workshop for the Engineering Branch was completed and a 55 k.w. A. C. generator installed. Installation of an air-conditioned withering chamber in the factory was completed.

### **Lecture Courses :**

The Agronomist, Asst. Botanist, and Actg. Plant Pathologist ran two demonstration courses on Vegetative Propagation from the 7th—8th July and 10th—12th July. Forty-two visitors attended the courses. The following members of staff gave lectures on tea to the students of the Assam Agricultural College :

|                                       |     |                                |
|---------------------------------------|-----|--------------------------------|
| The Agronomist                        | ... | 8 lectures                     |
| The Tea Taster                        | ... | 2 lectures and a demonstration |
| The Advisory Officer,<br>Assam Valley | ... | 2 lectures                     |



**Conference :**

The Annual Tocklai Conference was held on December 1st, 2nd, and 3rd.

**Scientific Department Sub-Committee :**

Two meetings of this Committee were held at Tocklai during the year — one on 30th June and the other on 4th December.

**Other Meetings :**

The Director and the Advisory Officer, Assam Valley attended the Annual General Meeting of the Assam Branch Indian Tea Association at Tezpur. The Advisory Officer, Assam Valley, attended the Annual General Meetings of the Surma Valley Branch Indian Tea Association, the Pakistan Tea Association, the Assam Tea Planters' Association, Sibsagar, and the United Planters' Association, Southern India. He also attended the Scientific Conference of the latter association. His tour report forms Memorandum No. 23.

**Visitors :**

Visitors were so numerous during the year that it has become necessary to adhere to one visiting day per week (Tuesdays) except by special arrangement with the Director.

**Publications :**

One Memorandum was published during the year :

Memo No. 24 — Wood Supplies on Tea Estate by R. I. Macalpine and the following Tea Encyclopaedia Serials :

## Serial No.

|      |                                                                                  |                              |
|------|----------------------------------------------------------------------------------|------------------------------|
| 88   | Packing of tea samples sent to Tocklai for tasting                               | D. J. Wood and J. M. Trinick |
| 89   | Longevity of Tea                                                                 | N. G. Gokhale<br>W. Wight    |
| 90   | Manuring of seedbaries                                                           | N. G. Gokhale                |
| 91   | Key for identification of common root diseases of tea                            | K. C. Sarmah                 |
| 92   | Key to identification of common diseases of young tea plants in nursery or field | K. C. Sarmah                 |
| 93   | Organisation of spraying                                                         | P. M. Glover                 |
| 94   | Scavenger termites                                                               | G. M. Das                    |
| 95   | Release of Tocklai vegetative clones                                             | C. J. Harrison               |
| 96   | Release of Tocklai generative clones                                             | C. J. Harrison               |
| 97   | Denaturing of tea waste                                                          | P. M. Glover<br>D. J. Wood   |
| 10/1 | Pruning of young tea ( Assam kinds )                                             | S. K. Dutta<br>P. M. Glover  |
| 42/1 | Thread Blight                                                                    | K. C. Sarma<br>P. M. Glover  |

**Work of the Station.**

At Borbhetta Experimental Estate over forty field experiments and nineteen breeding schemes are in progress. The study of the affect of nitrogen and artificial shade on various commercial jats of tea is being continued. The effect of different forms of nitrogen, viz., ammonia, nitrate, and urea, and organic bulky nitrogen is being tested under three different light intensities. The search continues for a relation between taxonomic characters and quality.

In 1948 an experiment was started to ascertain the best time and method of planting *Albizia stipulata* trees (shade trees). Planting was done in March, July, September, November, and January with and without a ball of earth (bheti) around the roots and in holes two and three feet deep. The conclusions reached were: (1) Planting of *A. stipulata* may be commenced in January and carried on until March. If planted in March, planting with a bheti is better than planting without this. (2) A two foot hole is sufficient.

The advantages of pruning a two year seed-nursery were examined. The indications are that with Assamica types of tea a reasonably high prune at the end of the first year, i.e. at about 16" from the ground, and then one skiff during the rains at about 24" from the ground is likely to produce better plants in the nursery. These results are now being followed up with plants transplanted into the field. With the Sinensis type harder pruning in the nursery does not have much affect.

In the Plant Pathology Branch the life histories of the *purple and pink mites* and method for their control are being studied. These mites have been observed at Tocklai and at Borbhetta and on a neighbouring garden. Work on *red spider* control to date has shown that lime sulphur with high polysulphide content is still the most effective treatment. A mixture of "Ovotran" and lime sulphur is being tested.

A disease of young leaves and green succulent stems of tea caused by a species of *Botrytis* was observed



on a local garden. The fungus first attacked the flowers of *Crotalaria anagyroides* (green crop) and was transmitted to the tea by the infected material dropping on to the latter. The fungus is capable of infecting tea very rapidly under damp, shady conditions. It has not been reported previously on tea.

Two distinct species of *Nectria* have been observed in the experimental area at Tippuk. The perithecia in one case are cream coloured and in the other red. The species producing cream coloured perithecia has been identified by the Commonwealth Mycological Institute as *Nectria ochroleuca* and is probably identical with a saprophytic species already recognised by Tocklai and called *Kallyden Nectria*. The second species is believed to be a parasitic one. Its pathogenicity is being determined in the laboratory.

The efficacy of "Intox 8" emulsion against *aphids* on *Crotalaria* has been established. Pyrocolloid plus D.D.T. has been used effectively against tea seed bugs in field trials. The life history of the tea seed bug is being studied.

No winter sprays were of much value in controlling *red-rust* but "Perenox" and "Ovocide" delayed the development of the fructifications.

Trials with a mercurial seed dresser (Tillex) on seeds of *Crotalaria* and *Tephrosia* showed that these seeds can be effectively protected from fungal infection in storage for about nine weeks by applying "Tillex" at the rate of 300 grams

per 100 kilograms. Germination of the treated seeds after three months was more than double that of untreated seeds.

Both D.D.T. and B.H.C. gave one hundred per cent control of *tineid caterpillars* on shade trees.

Observations have been made at fortnightly intervals throughout the year of seasonal variations in *eelworm* population at different soil depths. Although the maximum concentration is in the top 6" the eelworm is found at a depth of 18" from the surface. Methyl bromide fumigation of the soil has proved to be the most effective control measure to date.

In control measures against *black rot*, spraying with copper fungicides at two concentrations, 0.25 and 0.50 per cent, has shown that the lower concentration is the more effective and the most suitable time for spraying is mid-April to the end of May.

A high incidence of brown root rot has been reported in the Dooars. Complete eradication of diseased bushes and their surrounds appears to be the only reliable control measure.

"Aldrin" and "Dieldrin" have been proved effective in reducing the incidence of termites. Gammexane D 0.25 has proved to be a more efficient prophylactic in the case of *plant lice* than lime sulphur alone or lime sulphur with D.D.T.

During selective weed killer trials Pressure Retaining Battery Knapsack Sprayers, Central Charge Pump filled, were tried out with both high and

low volume nozzles. The most satisfactory low volume nozzle used was the Fan Jet C. 60. With high volume nozzles 130 gallons of liquid were required to cover an acre. With low volume nozzles adequate coverage was obtained with only 24 gallons and there were indications that a lower figure would be practicable.

Trials have shown that mist-blowing spraying machinery using water-based sprays is unsatisfactory in N. E. India. Oil-based mist-blown sprays, however, give adequate coverage and using a *single application* of 2 gallons liquid per acre, there was no scorching of leaf and no taint of the tea made from sprayed leaf.

Repeated applications of oil-based sprays have been shown in Ceylon to cause both scorch and taint. Mist sprayers give top surface cover only and, although adequate for blister blight, this is unsuitable for an all-purpose spray. The majority of tea pests require a spray that will penetrate the top hamper and reach the maintenance leaf and frame.

Further field trials of *Nectria* have shown that the danger period for infection is December to July. The spores enter the tea plant at any point at which the bush is damaged. Hail damage during April—May or damage due to borers or caterpillars expose the tissues to attack. In an area prone to *Nectria*, pruning and cleaning out should only be undertaken between August and December. Cut surfaces may be effectively protected by applying tar distillate.



Vegetative clones were issued in Assam and in Darjeeling.

The permanent wilting percentage of Tocklai soil was determined. At the point of permanent wilting Tocklai soil contained  $6.31 \pm 0.10\%$  moisture compared with river sand  $1.00 \pm 0.03\%$ . The method used is described in the report of the Physical Chemist.

A systematic study of the cation exchange complex of the main soil types of N. E. India and of the changes brought about by different manurial treatments has been started.

In connection with a study of the mechanism of soil aeration under field conditions in a tea area the carbon dioxide concentration of the soil air has been determined at two levels below the surface (6" and 12") and of the air under the tea canopy at different times of the day. The carbon dioxide concentration at 6" below the surface exceeds two per cent and the maximum concentration is nearly twenty times the corresponding figure for the atmosphere. The carbon dioxide concentration increases rapidly with depth. The maximum concentration of carbon dioxide in soil air is reached at mid-day and the minimum occurs sometime at night.

With the reduction of staff caused by the resignation of Dr. Roberts the biochemical research programme has been curtailed. It is hoped that a second scientific officer will be appointed to this branch in 1953.

The tasting of fractions of a tea infusion and examination of the effect of adding pure chemicals known to be normally present in tea to a tea infusion has been continued.

Miniature manufacture of leaf from Tocklai clones has given encouraging results. Two clones in particular carried good tip and threw a second-flush liquor right up to the end of September.

In single bush manufacture with "Pizey" rollers a thirty-minute roll with additional pressure was compared with a sixty-minute roll. The latter gave teas better in colour, strength, quality, and briskness. It is strongly recommended that sixty minute rolling be given by all Estates undertaking single bush manufacture.

Single bush manufacture with China hybrid types of tea and with big-leaved Assam types, both grown in the Darjeeling area at high elevation indicates that the *Assamic* type grown at high elevation yields a tea with colour and strength comparable to Assam grown tea but with additional flavour. Although not conclusive, these trials suggest that locality is an important factor in the production of flavour.

In an investigation of the influence of delayed withering of leaf a quantity of leaf was divided into two portions, the first of which was subjected to a natural wither of 18—20 hours from plucking; the second portion was kept for 24 hrs. in a closed cabinet at 100% relative humidity prior to natural withering for 18—20 hrs. The percentage

wither was approximately the same in both cases (70—72%). The two portions were manufactured separately under identical conditions and the resultant teas tasted by five tea tasters. Difference of opinion among the tasters precluded the drawing of definite conclusions but the indications are that "holding over" of the leaf, under the conditions of the experiment, had no detrimental effect on the finished tea.

Preliminary trials have been run with the air-conditioned withering chamber which will be used when the new season's leaf becomes available to determine the optimum conditions and duration of withering.

## **AGROBOTANICAL BRANCH :**

### **PLANT PHYSIOLOGY AND PROPAGATION.**

#### **(1) Sulphate of ammonia and light intensity ( para. 5 of 1951 ).**

A more complete knowledge of the growth of the tea plant than is given by the yield of plucked shoots is necessary for an understanding of the effects of light intensity and nitrogen. Much fundamental knowledge will remain obscured so long as the discussion of the results remains confined to the weight of leaf removed by plucking.<sup>1</sup> A clearer indication of the interactions was obtained this

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<sup>1</sup> — so also will some practical knowledge, for the selection of potential seed bearers necessarily takes place before it is possible to pluck the plant.



year from the sums of annual prunings plus plucked leaf. A still better picture of the factors which influence yield might be obtained from plants which are neither pruned nor plucked. These considerations govern the future programme of work in this field. The studied populations of plants have been categorised systematically by a crude index value. The index value has been derived by giving weight to the frequency of four basal types each being **subjectively defined**. Further mathematical treatment of an index value is considered to be undesirable until physically definable taxonomic criteria are more fully investigated ; and further mathematical treatment is again undesirable until the genetical interrelations of the basal types are more precisely formulated. Work is proceeding along both these lines. Meanwhile the technique of field surveys of the four basal types is being developed.

#### AGRONOMICS AND BREEDING.

##### (2) **Selection of seed bearing plants.** ( para 8 of 1951 ).

The rapid production of improved seed using the material and facilities of an ordinary tea garden has been attempted. In 15 acres of plucked bushes, the pubescent plants were marked and the glabrous plants uprooted. The surviving plants were left for the purpose of seed production. The plants being of considerable age, some seed may be expected within two years : but as the selected plants occur at random, the final spacing is irregular and the area may prove troublesome to manage ; and the method would be impracticable

except in an area with an unusually high proportion of pubescent plants. This factor is recorded automatically as part of an agrotype survey. We are indebted to the Jorehaut Tea Coy. for providing us with the facilities for this work.

### (3) **Albizzia stipulata — time of planting.**

An experiment commenced in 1948 had already established March as the optimum season for planting *A. stipulata*. In February of 1951 the top part of the surviving trees was weighed. It was found that *the weight of a tree in a particular population is inversely proportional to the number of deaths which has occurred in the population*. This principle is well known in the vegetative propagation of tea. The surviving trees were not able to overcome an initial disadvantage in a period of four years and it is likely that slight differences in the initial conditions to which the seedlings are subjected set up a cumulative divergence between the populations.

March planting: Deaths 0 Weight of a tree 130 lbs.

|          |   |     |    |   |
|----------|---|-----|----|---|
| January  | „ | 25% | 57 | „ |
| November | „ | 35% | 40 | „ |
| May      | „ | 45% | 50 | „ |
| July     | „ | 85% | 23 | „ |
| Sept.    | „ | 90% | 7  | „ |

The recorded number of deaths had occurred within two years of planting ( 1950 )

### (4) **Nursery plants — heading back.**

It has previously been established that this is a detrimental practice. It may be avoided by the use

of one year old plants. If two year old seedlings are used they may attain a length which causes the ball of soil around the roots to break by leverage. This has resulted in various heading back practices in the nursery in the belief that the final formation of a bush frame is hastened. It was desired to investigate sufficient treatments to formulate an opinion on the value of these practices relative to the simple alternative of heading back of the main stem at the time of lifting. When this latter practice is followed, the normal amount of root growth to be made in the nursery is not reduced but a large amount of top growth is sacrificed at the time of transplanting. The two year formative period in the nursery was completed this year and the plants have been put in the field for comparison with those previously untreated but now headed back at the time of removal from nursery to field. The indications are that any form of nursery control of growth reduces the weight of both roots and shoots up to the time of lifting : and the various formative processes appear to be detrimental ( to the natural amount of root and shoot growth ) in proportion as they prevent extension growth. The cumulative long term effect remains to be seen. The effects of the treatments were most pronounced in the Assam indigenous types and least marked in the China types ; as this distinction is often a matter of degree, the effect of nursery manipulation in reducing total growth may sometimes escape notice or be insignificant, depending upon the kind of plant which is being grown.



**(5) Transplanting baskets.**

For the distribution of plants raised by vegetative propagation, bamboo baskets have been used in lieu of the pots of European practice. It was necessary to find an efficient bamboo preservative which has no ill effect on the growth of the contained plant. The trials showed a combination of the commercial preparation 'Cuprinol' with "Gammexane" L. G. 140 (1 : 50) to be satisfactory.<sup>2</sup> The treatments, eleven in all, are being repeated on the lath frames used in propagation practice, an essential criterion in this case being the absence of any long term detrimental effect associated with the drip of rain water through the frame.

W. Wight

• Plant Physiologist.

S. K. Dutta

Agronomist.

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<sup>2</sup> Since the commencement of this experiment, "Gammexane" L. G. 140 (10% Gamma BHC) has been replaced by the manufacturers with "Gammexane" L. G. 240 (20% Gamma BHC), which can be used at half the concentration of L. G. 140. This is an expensive product and hence it is suggested that "Gammexane" Liquid Larvicide (10% Gamma BHC) might possibly be used at the same concentration as "Gammexane" L. G. 140.

## **Appendix to Agrobotanical Branch Annual Report, 1952.**

### **Staff.**

Dr. W. Wight, the Plant Physiologist was on Home Leave from the 16th March to 31st October, 1952, with two months leave in hand. This will be utilised latter.

There has been no change in the staff.

### **Labour.**

The average daily attendance during the whole year was :—

|           |   |        |
|-----------|---|--------|
| Tocklai   | — | 18.20  |
| Borbhetta | — | 306.29 |

Rice allowance was given to the labour during the year from annas -/8/- to Rs. 2/9/- on a sliding scale.

### **Crop yield.**

The total yield of green leaf during the year compared with that of 1951 was as follows :—

|      |   |               |
|------|---|---------------|
| 1951 | — | 2,59,589 lbs. |
| 1952 | — | 2,46,184 lbs. |

The general plucking was stopped as from the 17th October.

2,28,790 lbs. of green leaf were sold to Cinnamara Tea Estate at Rs. 17/8/- per 80 lbs.

### **Advisory.**

The Agronomist wrote 153 technical memoranda during the year.

### **Lectures.**

The Agronomist gave one lecture on Food crops in the Hygiene course of the Ross Institute and one lecture on the effect of plucking on yield, yield distribution and quality at the Tenth Annual Conference. He, assisted by the Assistant Botanist and the Acting Plant Physiologist, ran two demonstration courses on Vegetative Propagation on the following dates :—

7th and 8th July, 1952.

10th to 12th July, 1952.

### **BIOCHEMICAL BRANCH.**

#### **GENERAL.**

##### **1. Staff.**

Mr. Wood, Biochemist, was on leave from the end of January to early October. During his absence Mr. S. N. Sarma was in charge of the Department.

##### **2. Advisory and Touring.**

During the year 20 memoranda and advisory letters were issued. After returning from leave Mr. Wood visited one garden in the Nowgong District.

##### **3. Publications.**

Encyclopædia Serial No. 88, dealing with the packing of tea samples, was issued jointly with the Tea Taster ; Encyclopædia Serial No. 97 on the denaturing of tea waste was issued jointly with the Advisory Officer, Assam Valley.



## FUNDAMENTAL RESEARCH.

## I. Soluble Nitrogen Increase During Withering in Different Botanical Types.

As reported previously, both from Tocklai and from other tea research stations, during withering there is an increase in the water-soluble nitrogen of the leaf. While this is certainly not the only chemical change which occurs, and may not be responsible for the associated change in liquor characters, it is the only one which we are at present able to measure accurately. The fact that the soluble nitrogen increases progressively with the duration of withering, and is accompanied by a steady change in liquor characters, shows that it merits attention.

In an experiment this year leaf of different botanical types was withered under standard conditions, the water-soluble nitrogen being measured before and after withering. The following leaf was used :—

- (1) Bulk leaf from Stock 15 (Singlo), representing *assamica*.
- (2) Bulk leaf from Stocks 128, 129 and 130, representing *sinensis*.
- (3) Leaf from selected bushes of Stock 124, representing *cambodiensis*.

The experiment was performed on fourteen different dates, the figures below being the means of these fourteen determinations.

|              | Wither<br>% | Nitrogen<br>Fresh | Nitrogen<br>Withered | Nitrogen<br>Increase. |
|--------------|-------------|-------------------|----------------------|-----------------------|
| Assamica     | 66.3        | 2.04              | 2.26                 | 0.22                  |
| Sinensis     | 64.5        | 1.40              | 1.60                 | 0.20                  |
| Cambodiensis | 67.9        | 1.52              | 1.73                 | 0.21                  |

There is no statistical difference between the nitrogen increase of the three types although the differences in nitrogen of the fresh leaf are highly significant. On different dates there was considerable variation both in percentage wither and nitrogen increase but with no correlation between them. These results are substantially the same as those obtained in a similar experiment last year.

The figures show that the average degree of wither is not the same in the three types, *sinensis* leaf having lost significantly more moisture than *cambodiensis*. The degree of wither of *assamica* leaf is not significantly different from either of the other two types ; its relative position, however, is the same as in last year's experiment. It should be stressed that this difference in rate of withering does not necessarily apply in the same order to the three botanical types in general, but may be a property of the particular sources examined. In fact the view among the planting community is usually that China leaf withers at a slower rate than Assam leaf.

To sum up, it appears that, within the limitations of this experiment, the increase in soluble nitrogen during withering does not depend upon the botanical type of the leaf, on the nitrogen level in the fresh leaf or on the degree of wither. It follows that the fairly marked variation in soluble

nitrogen increase noticed on certain dates is due to factors other than those under investigation.

## 2. Enzymic Oxidation of Catechin Polymers.

Dr. A. E. Bradfield, while working for the I. T. A. (London) on the chemistry of made tea, showed that the products formed during the fermentation process, as a result of the oxidation and subsequent condensation of catechins, could be roughly separated into those of relatively low molecular weight, which could be extracted from an aqueous infusion by ethyl acetate, and those of higher molecular weight which could not be so extracted. He further showed that the ratio of "low polymer" to "high polymer" decreased as fermentation time increased, and that the value of this ratio had a marked effect on liquor characters. There appeared also, judging by the ease of separation of the two, to be a fairly sharp distinction between them.

Following up this work, Dr. Roberts, the I. T. A. (London) Research Officer, has prepared various fractions of "low polymer" and "high polymer" from a sample of made tea, and sent one fraction of each to Tocklai for examination. In an endeavour to detect some fundamental difference between the two we have measured the amount of carbon dioxide evolved when each in turn is oxidised to completion by the oxidative enzyme of tea leaf in the presence of *d*-catechin. We have previously shown that, by such treatment, polyphenols containing catechol but not pyrogallol groupings evolve no  $\text{CO}_2$ , while polyphenols containing pyrogallol groupings do evolve  $\text{CO}_2$ . It has also been shown

that the catechins of green tea leaf consist of (1) simple catechins containing one catechol group per molecule, (2) gallo catechins containing one pyrogallol group per molecule, (3) galloyl esters of the simple catechins containing one catechol and one pyrogallol group, (4) galloyl esters of the gallo catechins containing two pyrogallol groups. If the "low polymer" and "high polymer" respectively are derived from different types of catechin it is possible that they will also contain different proportions of pyrogallol groups, in which case the amounts of  $\text{CO}_2$  evolved on complete enzymic oxidation will differ.

By experiment, the following figures were obtained, using in each case 5 mg. of the polymer fraction, 10 mg. of *d*-catechin and 20 mg. of powdered enzyme preparation. The figures for enzyme and catechin alone have been subtracted from those with the complete mixture to give the figures in respect of polymer.

#### Low Polymer.

|                       |   |                |
|-----------------------|---|----------------|
| $\text{O}_2$ consumed | = | 58 microlitres |
| $\text{CO}_2$ evolved | = | 32 microlitres |
| R. Q.                 | = | 0.55           |

#### High Polymer.

|                       |   |                  |
|-----------------------|---|------------------|
| $\text{O}_2$ consumed | = | 85.5 microlitres |
| $\text{CO}_2$ evolved | = | 49.5 microlitres |
| R. Q.                 | = | 0.58             |

The R. Q. (ratio  $\text{O}_2$  to  $\text{CO}_2$ ) is very similar in each case, so that there does not at first sight appear to be any appreciable difference in



the proportions of pyrogallol groups in the two fractions. However the experiment is unsatisfactory in some respects ; in particular the figures as a whole are considerably lower than was expected, specially in the case of the "low polymer", making it doubtful whether complete oxidation has in fact been attained, and also increasing the percentage effect of any experimental error.

The above example, although permitting no definite conclusions in itself, serves as an introduction to a new line of research which it is intended to pursue as and when further samples of fractions come to hand. Other techniques, particularly chromatography, will be used in addition to the one outlined above in order to elucidate the chemical nature and origin of the various fractions. The investigation is of some considerable importance in view of the known relation between catechin polymers and liquor characters.

### 3. The Volatile Constituents of Tea.

Some preliminary experiments have been started on methods for extracting and identifying the volatile constituents of tea. As soon as an Assistant Biochemist is appointed this work will be continued on an increased scale.

The volatile substances are, of course, responsible for the flavour of Darjeeling teas and it is intended that these should receive special attention. The investigation will be aimed at assessing the amount of variation between the volatile substances of different bushes, clones, sections of a garden etc., and the chemical changes which occur during all

stages of manufacture. However, volatile substances are also of importance in Plains teas, since these also have characteristic aromas, and an attempt will be made to determine to what extent they affect quality in the Plains.

The volatile constituents of tea have not previously received very much attention at Tocklai, chiefly owing to the laborious nature of the work involved and the extremely small amounts present in tea. However, by employing techniques different from those used in the past, probably involving extraction with low boiling solvents and separation by some form of chromatography, it is hoped to be able to analyse much smaller quantities of material.

#### MANUFACTURING EXPERIMENTS.

##### 1. Pizey Rollers : Effect of Reduced Time of Rolling.

During the past few years many gardens have started single bush manufacture in Pizey rollers, as part of a programme of bush selection for vegetative propagation. In some cases, owing to insufficient Pizey rollers, Managers have experimented with a single half-hour roll using extra pressure in place of the one hour roll which Tocklai advise. When samples manufactured in this way have been sent to Tocklai for tasting, they have usually been noticeably lacking in colour and strength. In order to determine whether it is possible to obtain adequate results with this system an experiment was performed in which samples of the same leaf were rolled (1) for one hour using normal pressures, (2) for half-an-hour with greatly increased pressures.

The experiment was performed in triplicate on twelve occasions, resulting in 36 samples manufactured by each method. Those rolled for one hour were very significantly better in colour and strength than those rolled for half-an-hour. On several occasions the former were also better in quality and briskness. Bearing in mind the fact that even when rolled for a full hour, Pizey samples are definitely a little light in cup compared with commercial teas, it seems that a half hour roll in Pizey rollers using extra pressure cannot replace the standard one hour roll.

## 2. The Effect of a delayed Wither on Liquor Characters.

The withering experiment carried out in 1951, which was discussed at some length in the Annual Report for that year, gave among other things a comparison between a tea withered for the normal length of time and a tea withered artificially in much less than the normal length of time. The former possessed characteristics which were not apparent in the latter, and reasons were given for concluding that the difference was due to chemical changes during withering which were associated with the duration of withering rather than with loss of moisture. In extension of these findings comparison has this year been made between a normal tea and one withered for much more than the usual length of time.

Leaf after bulking was divided into two portions. The first portion (normal wither) was spread on chungs and manufactured 18-20 hours after plucking.

The second portion (delayed wither) was first stored for 24 hrs. in a completely humid atmosphere, during which period no appreciable loss of moisture occurred. It was then spread for withering and manufactured 42-44 hours after plucking. The average percentage wither was 71.9% for the normal and 69.6% for the delayed wither. Subsequent manufacture of both portions was identical. The experiment was performed on nine occasions from the 21st August to the 3rd October, and samples of the teas were sent to five Tasters.

The reports these teas received were rather conflicting. Three Tasters preferred the delayed wither for colour and strength and noticed no significant difference in quality or briskness. One of these Tasters (the only one of the five to submit a complete set of valuations) valued the delayed wither one anna four pies better than the normal. A fourth Taster in contrast preferred the normal wither for all four liquor characters. The fifth Taster made no significant difference between the two teas in respect of any of the liquor characters. Only once was the delayed wither reported on as possessing a character suggestive of slight bacterial infection.

In view of our previously expressed opinions on the effect of a prolonged wither on liquors, and particularly on the practice of "holding leaf over" during periods of adverse withering conditions (Encyclopædia Serial No. 55), it is certainly surprising that only one Taster considers that an extended wither is actually detrimental to the teas. Conflicting opinions make it impossible to draw firm conclusions.



But it seems questionable whether our previous views on the ill effects of "holding leaf over" were not perhaps a little pessimistic. It should however be emphasised that on a commercial scale the leaf would be much more liable to bacterial infection, and the character of a tea made from leaf "held over" by a garden might well be determined to a large extent by the general state of the withering houses.

### 3. Withering Machine.

The withering machine, after many delays, eventually arrived at Tocklai during the year and was assembled by the Resident Engineer. It was not fully operational until the end of December, so that experiments involving the machine which had been planned for 1952 had to be postponed until 1953. A few performance trials were carried out during November, chiefly to test certain aspects of the running of the machine ; at the same time however some preliminary information was obtained about the rate of withering of leaf under different conditions.

With the machine it is possible to control independently, and within wide limits, air speed, temperature and relative humidity. It is intended, in the first place, to determine the rate at which leaf withers using different combinations of these three variables. On the chemical side, the separate effects of temperature and relative humidity on liquor characters will be studied, and an attempt will be made to find out the optimum duration of withering. The latter is particularly important,

as indicated by experiments during the last two years. It will not however be a simple matter to investigate, since the optimum duration is likely to depend on factors such as the physical conditions during withering, the inherent characters of the leaf, and the market for which the tea is destined.

The object of this intense investigation of withering is to see whether the process can with advantage be brought more under control in N. E. India than is the case at present, as it is felt that the present methods and conditions of withering are a serious obstruction both to improvement of quality and to mechanisation of manufacture. Control in its simplest form would consist of blowing the natural atmospheric air over the leaf by means of fans. To go a stage further would involve provision for heating the air on days when the difference between wet and dry bulb temperatures was insufficient.

Coupled with the investigations at Tocklai it is necessary to have accurate information concerning wet and dry bulb temperatures throughout the year in the different tea districts. Very little information is at present available, but arrangements have been made for readings to be taken on a number of gardens.

D. J. Wood  
Biochemist.

## PLANT PATHOLOGICAL DEPARTMENT

### Staff

Mr. K. C. Sarmah has been in charge of the Mycological Section for the whole year. The Assistant Mycologist Mr. D. N. Barthakur resigned his post and left on the 9th of June.

Mr. W. P. Medhi, the Assistant Entomologist also left the department on 10th November.

### Bacteriology

Weekly bacteriological tests of the Tocklai water supply were carried out throughout the year with the following results.

#### Mean number of lactose fermenting bacteria per c.c. of water

|           |     | Untreated | Treated |
|-----------|-----|-----------|---------|
| January   | ... | 2         | 0       |
| February  | ... | 2         | 0       |
| March     | ... | 7         | 0       |
| April     | ... | 10        | 0       |
| May       | ... | 24        | 0       |
| June      | ... | 19        | 1       |
| July      | ... | 22        | 0       |
| August    | ... | 10        | 0       |
| September | ... | 3         | 0       |
| October   | ... | 26        | 0       |
| November  | ... | 6         | 0       |
| December  | ... | 2         | 0       |

The water sterilising plant worked satisfactorily during the year.

Water samples from 6 estates were received and tested for bacterial contamination and treatments were suggested where necessary.

Laboratory trials were carried out with a 'Bactericide' named Vantoc A (supplied by Messrs. Imperial Chemical Industries (India) Ltd.,) in order to determine its inhibiting effect on Bacteria encountered in Fermenting floors, Rolling machinery, Withering lofts etc.

The bactericide was used at its recommended strength of  $\frac{1}{4}$  oz. per gallon of water and also at four times this amount (i.e. 1 oz. per gallon) against water-contaminating bacteria as well as bacteria from badly infected fermented tea leaf.

A contact of 15, 20 and 60 minutes with the product at  $\frac{1}{4}$  oz. per gallon, had no inhibiting effect, either on water polluting bacteria or on bacteria obtained from overfermented tea leaf.

A contact of 15 and 20 minutes at four times the recommended strength also had no effect.

## **Mycology**

### **Red Rust (*Cephaleuros parasiticus*)**

#### **Winter Spraying at Rungajan Tea Estate—**

Six different winter treatments were applied, to young tea known to be severely affected by Red rust, after pruning and before bud-break took place. There were 100 plants under each treatment.



Assessments were made during May and June with the following results.

| Treatments applied on<br>11/1/52                                        | Leaf<br>table on<br>15/5/52 | Variega-<br>tion on<br>15/5/52 | Fructification on |         |
|-------------------------------------------------------------------------|-----------------------------|--------------------------------|-------------------|---------|
|                                                                         |                             |                                | 15/5/52           | 13/6/52 |
| 1. Lime wash 5%                                                         | 80                          | 32                             | 81.0              | 63.2    |
| 2. Caustic soda plus lime                                               | 78                          | 38                             | 79.5              | 53.5    |
| 3. Caustic soda 1.5%                                                    | 78                          | 44                             | 79.0              | 56.7    |
| 4. Perenox 0.5% plus<br>Tar oil 5%                                      | 76                          | 28                             | 70.0              | 59.7    |
| 5. Perenox 0.5% plus<br>Ovicide 5%                                      | 77                          | 41                             | 56.0              | 54.5    |
| 6. Treatment 5 and<br>again Perenox 0.5%<br>plus Ovicide 1% in<br>April | 77                          | 39                             | 49.1              | 54.0    |
| 7. Control                                                              | 79                          | 54                             | 84.0              | 64.5    |

None of the winter treatments proved to be of much value in controlling the disease. Treatments No. 5 and 6 however delayed the development of the fructifications.

### Blister Blight

Outbreaks of Blister blight were reported from 34 estates (18 in Assam, 6 in Cachar, 7 in the Dooars, 2 in Sylhet and 1 in Terai) during the year. The attack was mild and confined to small areas except in 6 cases (2 in Assam, 3 in the Dooars and 1 in Cachar) where

it was reported to be severe. It was however brought under control by prompt action of the managements.

## **Black Rot**

### **Prophylactic treatment with different fungicides**

A prophylactic spraying experiment, with 9 copper fungicides, at two concentrations, (0.25% and 0.5%) at Hattichungi Tea Estate was started in the middle of March. 10 bushes were sprayed on two occasions at an interval of 2 weeks. The spraying was continued till the end of May.

Visual examination of the intensity of attack was made in the field at monthly intervals from June-September. The results are shown in the following table.

| Treatment period                 | Pere-<br>nox | Copper<br>Sandoz | Cuprox | Blitox | Ialine<br>copper | Coppe-<br>san | B. S.<br>fungi-<br>cide | Wetcol | Solto-<br>san. | Control |
|----------------------------------|--------------|------------------|--------|--------|------------------|---------------|-------------------------|--------|----------------|---------|
| <b>0.25%</b>                     |              |                  |        |        |                  |               |                         |        |                |         |
| 1st period<br>18/3/52 to 14/4/52 | 36.5         | 27.0             | 21.0   | 18.5   | 35.5             | 33.5          | 23.5                    | 27.5   | 24.0           | 43.5    |
| 2nd period<br>14/4/52 to 28/5/52 | 12.0         | 18.6             | 22.0   | 17.0   | 19.0             | 18.0          | 14.0                    | 17.0   | 22.0           | 34.0    |
| <b>0.5%</b>                      |              |                  |        |        |                  |               |                         |        |                |         |
| 1st period                       | 40.0         | 23.0             | 20.5   | 28.0   | 34.0             | 38.0          | 24.0                    | 29.0   | 35.5           | 48.5    |
| 2nd period                       | 15.0         | 20.0             | 17.0   | 19.0   | 18.0             | 15.0          | 12.0                    | 20.0   | 19.0           | 31.0    |

It appears from the above figures.

- (1) that the fungicides in many cases proved to be more effective at 0.25% concentration than when they were used at double the strength. This was observed in a few instances previously.
- (2) that prophylactic treatment during the period from middle of March to middle of April had no appreciable effect on the control of the disease. Treatments applied between mid-April and end of May were effective in reducing the incidence of the blight to a considerable extent except in case of two of the fungicides viz., Cuprox and Soltosan. The results agree with our previous observations and confirm the view that the most suitable period for prophylactic treatment is between mid-April and the end of May.

### **Treatment with high and low volume spraying equipments**

Spraying with high volume equipment gave a slightly higher reduction than with low volume equipment but the results are not statistically significant.

### **Nectria experiment at Tippuk**

Certain unforeseen complications in the manifestation of the disease were noticed in the course of investigations.

It has been found that two species of *Nectria* are prevalent in the experimental area at Tippuk.

Both of them produce conidial fructifications which are similar in appearance, to the naked eye, but the perithecia in one case are cream coloured while in the other they are red.

All species of *Nectria*, so far observed on tea, produce pinkish-white conidial fructifications. It is only possible to distinguish the different *Nectrias* by careful examination of the perfect stage (perithecia) under the microscope.

Cultures made from Tippuk material (conidia) and taken by the Scientific Officer, Jokai (Assam) Tea Co., Ltd., to U. K. have been identified by the Commonwealth Mycological Institute as *Nectria ochroleuca*, which produces cream coloured perithecia. This species is probably identical with a saprophytic species already recognised by Tocklai as Kellyden *Nectria*.

It is quite clear that the second species, producing red perithecia, is quite distinct from *Nectria ochroleuca* and it is believed to be a parasitic one. Its pathogenicity can only be determined by inoculation experiments made with isolations of the fungus in culture, from the perithecial stage.

This work is being continued by the Scientific Officer, Jokai (Assam) Tea Co., Ltd. with some modifications made according to our suggestions. Pure cultures of the parasitic species of Tippuk *Nectria* have been supplied by us for inoculation purpose.



An inoculation experiment has also been started at Tocklai to ascertain the pathogenicity of this virulent species of *Nectria*. Pure cultures, obtained from the perithecial stage of the fungus, are being used for infecting a definite number of pruning cuts every month commencing from November 1952. This work will be continued for at least 12 months.

### **Eelworms (*Heterodera marioni*).**

An experiment was carried out at Tocklai to test the effect of the following fumigants on the control of Eelworms in Tea Nurseries.

- (1) Dowfume S 1128, at the rate of 200 lbs. per acre injected into the soil at 6" from the surface with an injector.
- (2) Cyanogas G, at the rate of 5 lbs. per 100 sq. ft. poured, in equally divided doses, into 1 ft. deep holes, 12" apart each way.
- (3) Cyanogas A—Same as Cyanogas G.
- (4) Control.
- (5) Methyl Bromide—2 ampoules of 20 cc. each, crushed at a depth of 6" from the surface (i.e. 1 ampoule in the centre of an area of 6'×6').
- (6) Methyl Bromide—1 ampoule of 20 c.c. crushed at the centre of the bed (6'×12') at 6" below surface.

Six beds of 72 sq. ft. (6'×12') were prepared in late October 1951. Treatments were applied on all beds except No. 2 in the 3rd week of December 1951. Treatment No. 2 had to be delayed till the middle of January due to late arrival of the product.

120 tea seeds previously germinated in river sand, were sown after 2 weeks of the above treatments. On bed No. 2 seeds were sown in the 1st week of February 1952.

The soil pH and Eelworm population were determined before and after treatment. As the soil pH in plots 2 and 3 was on the high side, 4 ozs. of sulphur powder (@ 150 mds. per acre) was mixed with the soil on each of these beds before planting.

The seedlings were uprooted after 6 months from the date of planting and examined for Eelworm infection. The results are tabulated below.

| Treat-<br>ments | pH                      |                                 |                                       | Eelworms in 10 gms. of soil |                                 |                                       | Seedlings |                               |                                                 |
|-----------------|-------------------------|---------------------------------|---------------------------------------|-----------------------------|---------------------------------|---------------------------------------|-----------|-------------------------------|-------------------------------------------------|
|                 | Before applica-<br>tion | 2 weeks<br>after treat-<br>ment | Six<br>months<br>after treat-<br>ment | Before treat-<br>ment       | 2 weeks<br>after treat-<br>ment | Six<br>months<br>after treat-<br>ment | Planted   | Survived<br>after 6<br>months | Found<br>to be<br>effected<br>after 6<br>months |
| 1.              | 4.99                    | 4.84                            | 5.09                                  | 22                          | 3                               | 6                                     | 120       | 48                            | 45                                              |
| 2.              | 7.22                    | 6.57                            | 7.59                                  | 13                          | 2                               | 0                                     | 120       | 31                            | 13                                              |
| 3.              | 6.51                    | 6.59                            | 6.78                                  | 8                           | 0                               | 0                                     | 120       | 21                            | 9                                               |
| 4.              | 5.05                    | 4.97                            | 4.78                                  | 7                           | 4                               | 2                                     | 120       | 104                           | 56                                              |
| 5.              | 4.85                    | 4.84                            | 4.55                                  | 12                          | 6                               | 2                                     | 120       | 77                            | 13                                              |
| 6.              | 4.61                    | 4.75                            | 5.09                                  | 13                          | 5                               | 7                                     | 120       | 85                            | 15                                              |

Except Nos. 5 and 6, none of the other treatments seems to have reduced Eelworm infection to any appreciable extent. The results however cannot be regarded as conclusive. Further work on this line is necessary. Treatment Nos. 1, 2 and 3, apart from being unsatisfactory in controlling Eelworms, had obviously a detrimental effect on the seedlings.

**Seasonal variations**

Observations on the seasonal variations in Eelworm population, at different soil depths, were made at fortnightly intervals throughout the year. Samples were obtained from a site known to be infested by the nematode. The following table shows the number of Eelworms per 10 gms. of soil.

| Month     | Dt. of observation | 1"-6" depth | 6"-12" depth | 12"-18" depth |
|-----------|--------------------|-------------|--------------|---------------|
| January   | 5                  | 3           | 9            | 0             |
|           | 17                 | 9           | 11           | 1             |
| February  | 4                  | 11          | 2            | 0             |
|           | 22                 | 14          | 4            | 1             |
| March     | 11                 | 9           | 1            | 22            |
|           | 27                 | 4           | 11           | 1             |
| April     | 9                  | 2           | 11           | 1             |
|           | 23                 | 9           | 8            | 2             |
| May       | 7                  | 4           | 3            | 2             |
|           | 21                 | 5           | 1            | 1             |
| June      | 4                  | 11          | 4            | 1             |
|           | 18                 | 11          | 5            | 1             |
| July      | 3                  | 6           | 2            | 1             |
|           | 17                 | 10          | 5            | 0             |
|           | 31                 | 5           | 4            | 1             |
| August    | 15                 | 3           | 1            | 1             |
|           | 28                 | 5           | 1            | 0             |
| September | 10                 | 6           | 4            | 1             |
|           | 24                 | 7           | 4            | 1             |
| October   | 8                  | 7           | 2            | 5             |
|           | 22                 | 5           | 3            | 1             |
| November  | 5                  | 9           | 4            | 1             |
|           | 20                 | 11          | 8            | 3             |
| December  | 3                  | 12          | 9            | 4             |
|           | 17                 | 5           | 6            | 3             |
|           | 31                 | 4           | 3            | 2             |

This work will be continued.

### **New Botrytis disease of tea**

A disease of the young leaves and green succulent stems of tea, caused by a species of *Botrytis* was observed on a local garden. The fungus first attacked the flowers of *Crotalaria anagyroides* shade and was transmitted to the tea growing underneath by the affected material which dropped on the latter.

The fungus grows very rapidly in culture and inoculations carried out in the laboratory as well as in the field with material from culture have shown that the fungus is capable of infecting tea very rapidly under damp shady conditions.

This disease has not been recorded on tea before.

### **Screening of Fungicide, Bactericide etc.**

Laboratory tests were carried out with a mercurial seed disinfectant 'Tillex' (supplied by Messrs. Atlas Fertilisers Ltd., and manufactured by Messrs. Sandoz Ltd.), in order to determine its protective value against fungal infection of seeds in storage.

4 ozs. of each of *Crotalaria anagyroides* and *Tephrosia candida* seeds were divided into 2 lots. One half was treated with 'Tillex' at the rate of 0.085 gm. per oz. (i.e. 300 gms. per 100 kg.) and the other half was left untreated.

After a week both treated and untreated seeds were inoculated with spores of *Fusarium* sp. The seeds were then kept in cloth bags on the laboratory table for one month after which 10 seeds from each lot were plated on Potato-dextrose-agar



medium at intervals of 2 weeks, for 3 months. The growth of fungi in culture was recorded as follows.

**Total number of seeds infected (by fungi such as Fusarium, Mould and Bacteria) out of 20.**

| Description of seed | Treatment             | After being in Storage for weeks |    |    |    |    |    |
|---------------------|-----------------------|----------------------------------|----|----|----|----|----|
|                     |                       | 5                                | 7  | 9  | 11 | 13 | 15 |
| <i>Tephrosia</i>    | Treated with 'Tillex' | 0                                | 0  | 1  | 1  | 1  | 5  |
| <i>Tephrosia</i>    | Control               | 20                               | 20 | 20 | 20 | 19 | 19 |
| <i>Crotalaria</i>   | Treated with 'Tillex' | 0                                | 0  | 0  | 2  | 1  | 4  |
| <i>Crotalaria</i>   | Control               | 20                               | 20 | 19 | 18 | 16 | 18 |

Germination tests of the *Crotalaria* seeds were made, after 15 and 20 weeks of application of the seed dressing, both in the open as well as in the laboratory with the following results.

**Total number of germinated seeds out of 200**

| Treatment             | Description of seed           | Number of germinated seeds              |                                               |
|-----------------------|-------------------------------|-----------------------------------------|-----------------------------------------------|
|                       |                               | In the open after 15 weeks of treatment | In the laboratory after 20 weeks of treatment |
| Treated with 'Tillex' | <i>Crotalaria anagyroides</i> | 91=45.5%                                | 92=46%                                        |
| Control               | - do -                        | 41=20.5%                                | 43=21.5%                                      |

Tephrosia seeds were not included in the germination tests as they were faulty to start with.

Some of the untreated seeds were found to be damaged by insects after 3 months but the treated ones were unaffected.

The above results show that *Crotalaria* and *Tephrosia* seeds can be effectively protected from fungal infection in storage for about 9 weeks by applying 'Tillex' at the rate of 300 gms. per 100 kg. Germination of treated seeds after 3 months was more than double that of untreated ones.

## Entomology

### Cricket control

Trials were carried out with 5% Benzene hexachloride (Gammexane D·025) applied as a dust @ 25 and 50 lbs. per acre over the nursery area at Borbhetta with the following results.

**Table I**

| Treatment                             | Number of freshly opened holes after treatment* |         |         |         |         |          |
|---------------------------------------|-------------------------------------------------|---------|---------|---------|---------|----------|
|                                       | 3rd day                                         | 5th day | 7th day | 8th day | 9th day | 11th day |
| 1. Gammexane D·025 (25 lbs. per acre) | 9                                               | 15      | 16      | 20      | 20      | 25       |
| 2. Gammexane D·025 (50 lbs. per acre) | 9                                               | 12      | 10      | 14      | 17      | 22       |
| 3 Check                               | 17                                              | 14      | 18      | 19      | 21      | 23       |

\*This may include holes made by new migrants from outside into the areas.

**Table 2**

| Treatments                            | Total number of holes before treatment | Number of freshly opened holes after treatment |         |          |          |
|---------------------------------------|----------------------------------------|------------------------------------------------|---------|----------|----------|
|                                       |                                        | 3rd day                                        | 9th day | 13th day | 14th day |
| 1. Gammexane D-025 @ 25 lbs. per acre | 105                                    | 69                                             | 47      | 72       | 79       |
| 2. Check                              | 112                                    | 134                                            | 91      | 87       | 92       |
| 3. Gammexane D-025 @ 50 lbs. per acre | 164                                    | 94                                             | 42      | 57       | 64       |
| 4. Check                              | 110                                    | 118                                            | 108     | 80       | 100      |

Holes could not be traced from 5th to 8th day due to heavy rain.

In the first trial, slight reduction in the population of crickets, as indicated by fresh holes, was obtained at the initial stage after treatments, but the residual action of BHC does not appear to remain effective for long against the new migrants from adjoining areas. In the second trial, there was however considerable reduction in the number of fresh holes on the 9th day in the plot treated with BHC @ 50 lbs. per acre. This might be due to heavy rain on the 5th day following the treatment. The number was however gradually increasing afterwards.

#### **Noctuid caterpillar (*Rhesala moestalis walk*).**

This caterpillar has been causing considerable damage to nursery plants of *Albizzia odoratissima*,

*A. stipulata* and *A. procera* and also to young *A. odoratissima* plants in tea. The caterpillar webs up the leaves and feeds inside and in a severe attack the plants are completely defoliated. In case of repeated attacks, the seedlings die back from the top and in extreme cases, they may completely die.

Field trials with DDT and BHC were carried out for the control of the pest at Borbhetta. 12 infested young *A. odoratissima* plants were selected for each treatment. Immediately after the treatments were applied most of the caterpillars dropped on the ground, suspended on silken threads and died within an hour or two.

Three of the treated plants selected at random in each treatment were examined for live caterpillars on the following day, but only a few dead caterpillars were found inside the webbed up leaves.

**Table 3**

| Treatments                                                  | Number of living caterpillars |    |
|-------------------------------------------------------------|-------------------------------|----|
| 1. DDT 50% W. P. as a spray, 1 lb. to 50 gallons of water.  | ...                           | 0  |
| 2. Agrocide W. P. as a spray, 1 lb. to 50 gallons of water. | ...                           | 0  |
| 3. Gammexane D-025 as a dust                                | ...                           | 0  |
| 4. Check                                                    | ...                           | 32 |

The above results indicate that both DDT and BHC are highly effective against the pest, and one

application of any of these formulations will control the pest.

The pest has, however, several overlapping broods in a year, and the residual action is not likely to remain effective for such a long time as to effect the subsequent broods. Obviously, further treatment will be necessary to deal with the pest after some time.

The caterpillars are found on the plants from April to October but the incidence appears to be heavy in May and June.

To find out the appropriate time and number of treatments necessary to deal with the pest, observations on the incidence of the caterpillar were made at Borbhetta from July to December. Further study is necessary.

### **Orange or Peel's Beetle**

Reports of severe damage caused by Orange beetle, particularly on young tea in new extension areas, have occasionally been received. In order to find out the efficacy of DDT and BHC in dealing with the pest in a severe attack, laboratory trials were conducted with the following results.



**Table 4****(1) Spraying the shoots with 10 beetles on**

| Treatments                                               | Number alive after |         |         |         |
|----------------------------------------------------------|--------------------|---------|---------|---------|
|                                                          | 24 hrs.            | 48 hrs. | 72 hrs. | 96 hrs. |
| 1. Guesarol DDT 50%,<br>1 lb. in 50 gallons of<br>water. | 2                  | —       | —       | —       |
| 2. Agrocide W. P., 1 lb.<br>in 50 gallons of water.      | 6                  | 3       | —       | —       |
| 3. Gammexane D-025<br>(Dust)                             | 5                  | —       | —       | —       |
| 4. Check                                                 | 10                 | 10      | 9       | 9       |

**Table 5****(2) Residual effect on 10 beetles introduced  
after 5 days of spraying.**

| Treatments                                               | Number alive after |         |         |         |
|----------------------------------------------------------|--------------------|---------|---------|---------|
|                                                          | 24 hrs.            | 48 hrs. | 72 hrs. | 96 hrs. |
| 1. Guesarol DDT 50%,<br>1 lb. in 50 gallons of<br>water. | 9                  | 8       | 7       | 3       |
| 2. Agrocide W. P., 1 lb.<br>in 50 gallons of water.      | 10                 | 10      | 8       | 5       |
| 3. Gammexane D-025<br>(Dust).                            | 8                  | 4       | 2       | 2       |
| 4. Check.                                                | 10                 | 10      | 8       | 8       |

Both DDT and BHC gave effective control of the pest. The residual action was found to be moderate.

### **Jassid**

Area No. 32 at Borbhetta was severely attacked by Jassid (Green fly) at the early part of the season when new growth had appeared after pruning. As a result of damage, the growth was completely checked, and the affected leaves crinkled and curled down, with the margins drying up. A few badly affected plants completely died.

Although Jassid damage is associated with a peculiar flavour which improves the quality of made tea in Darjeeling, no such marked flavour is found in the plains. In Darjeeling, no measure is adopted against it or against any other pest occurring simultaneously which might involve in checking Jassid, since the characteristic flavour might be lost. The extent of damage caused by Jassid to tea in Darjeeling is not known. Thrips which usually occur there along with Jassid, are usually accused of the damage which might have been caused by Jassid or by both. In the plains however, it has occasionally been reported to cause severe damage to tea in localised areas.

DDT at 0.1 per cent applied as a spray, gave effective control of the pest at Borbhetta.

**Table 6**

**Number of Jassids, on groups of 5 bushes, each selected at random, 15 days after treatment**

**A. Sprayed area.**

|       |   |     |   |
|-------|---|-----|---|
| Group | 1 | ... | 1 |
| „     | 2 | ... | 0 |
| „     | 3 | ... | 0 |
| „     | 4 | ... | 2 |
| „     | 5 | ... | 1 |

**B. Unsprayed area on the opposite side which was slightly less attacked than the sprayed area.**

|       |   |     |    |
|-------|---|-----|----|
| Group | 1 | ... | 95 |
| „     | 2 | ... | 83 |
| „     | 3 | ... | 87 |
| „     | 4 | ... | 76 |
| „     | 5 | ... | 82 |

It appears that DDT residue was quite effective against the newly hatched ones.

**Aphid**

In a field experiment Nicotine sulphate, Chlordane and BHC were tried out against Aphid on *Crotalaria anagyroides* with the following results.

**Table 7**

| Treatments                                            | No. of Aphids before treatment | No. of Aphids alive 4 days after treatment | % killed                      |
|-------------------------------------------------------|--------------------------------|--------------------------------------------|-------------------------------|
| 1. Chlordane (Intox 8)<br>1 lb. in 50 gals. of water. | 3062                           | Nil                                        | 100                           |
| 2. Nicotine sulphate, 1 lb. in 60 gals. of water.     | 5644                           | „                                          | 100                           |
| 3. Nicotine sulphate, 1 lb. in 100 gals. of water.    | 1803                           | 116                                        | 93.6                          |
| 4. Agrocide W. P., 1 lb. in 50 gals. of water.        | 5401                           | 3578                                       | 33.8                          |
| 5. Check.                                             | 937                            | 1132                                       | Population increased by 20.7% |

Both Nicotine sulphate and Chlordane gave 100% control of the Aphid, but Nicotine is one of the rapid and deadly poisons for higher animals and it is not safe for the operators to apply it without taking special precautions, although the nicotine sulphate is slower to produce convulsions than the alkaloid itself. On the other hand the toxicity of Chlordane to mammals is almost equal to that of DDT. It therefore appears that Chlordane would be quite suitable for control of Aphids.

## Termites

Two new synthetic organic insecticides viz. Aldrin and Dieldrin were tried out as soil treatments against termites attacking healthy tissues of tea bushes at Tarajulie T. E.

A plot consisting of 10×5 bushes was selected for each treatment. The insecticides were applied as sprays on the ground and forked lightly into the soil. Bi-monthly observations were made on the incidence of termites as indicated by earth runs, which were rubbed off immediately after recording.

**Table 8**

| Plot No. | Treatments                        | Number of earth runs |       |      |          |
|----------|-----------------------------------|----------------------|-------|------|----------|
|          |                                   | July                 | Sept. | Nov. | Jan. '53 |
| 1.       | Aldrin 50% W. P., 8 lbs. per acre | 2                    | 16    | 2    | 5        |
| 2.       | " " " 16 " " "                    | —                    | 2     | 3    | 4        |
| 3.       | " " E. C. 8 " " "                 | 2                    | 4     | 10   | 3        |
| 4.       | Dieldrin 50% W. P. 8 " " "        | 1                    | 3     | 8    | 3        |
| 5.       | " " " 16 " " "                    | —                    | 1     | 6    | 3        |
| 6.       | " " E. C. 8 " " "                 | 1                    | 3     | 4    | 5        |
| 7.       | Check ... ..                      | 11                   | 23    | 52   | 34       |



Both Aldrin and Dieldrin treatments gave considerable reduction in the incidence of termites in the treated plots. The persistent toxicity of these two insecticides has yet to be evaluated.

### Red spider.

A field trial to find out the comparative effectiveness of Lime sulphur, Colloidal sulphur and Wettable sulphur, against Red spider, was carried out at Borbhetta. Count of Red spider population (eggs not included) was made from 10 leaves collected at random from each treatment on the 10th day and again on the 15th day after treatment.

**Table 9**

| Treatments                                                                                  | Red spider population       |                             |
|---------------------------------------------------------------------------------------------|-----------------------------|-----------------------------|
|                                                                                             | on 10th day after treatment | on 15th day after treatment |
| 1. Ialine Colloidal sulphur, 1 lb. to 20 gallons of water.                                  | 22                          | 8                           |
| 2. Ialine Colloidal sulphur, 1 lb. plus $\frac{1}{2}$ lb. Sandovit, to 40 gallons of water. | 78                          | 52                          |
| 3. G-22914, 1 lb. to 25 gallons of water.                                                   | 26                          | 40                          |
| 4. „ „, 1 lb. to 50 gallons of water.                                                       | 46                          | 68                          |
| 5. Eclipse lime sulphur (25-28% polysulphide content), 1 in 40 parts of water.              | 5                           | 0                           |
| 6. Check                                                                                    | 232                         | 672                         |

There is no doubt that Lime-sulphur with high polysulphide content is more effective than colloidal and wettable sulphurs. Colloidal sulphur however gives slightly better results than wettable sulphur. The finer the particles of sulphur the more is the effectiveness.

### **'Ovotran'**

'Ovotran', a new acaricide, containing P-chlorophenyl, P-chlorobenzene sulphonate was tested against Red spider in the laboratory. This acaricide has high ovicidal action and gave 80-90% kill of the eggs. It has little effect on the active forms (nymphs and adults) which migrate shortly after the treatment is applied. A few migrating adults were kept on a leaf in a tube; they however deposited eggs within 24 hours.

**Table 10**  
**Effect of Ovotran on eggs and newly hatched larvae**

**Trial No. 1**

| Treatments                                              | Total number of eggs | Eggs un-hatched | % un-hatched | Effect on newly hatched larvae |                 |            |
|---------------------------------------------------------|----------------------|-----------------|--------------|--------------------------------|-----------------|------------|
|                                                         |                      |                 |              | Total number                   | Number affected | % affected |
| 1. Ovotran, 1 lb. to 50 gals. of water (thorough spray) | 463                  | 434             | 93.7         | 29                             | 28              | 96.6       |
| 2. Do-, 1 lb. to 50 gals. of water (moderate spray)     | 478                  | 421             | 88.1         | 57                             | 36              | 63.2       |
| 3. Do-, 1 lb. to 100 gals. of water (thorough spray)    | 471                  | 425             | 90.2         | 46                             | 33              | 73.9       |
| 4. Do-, 1 lb. to 100 gals. of water (moderate spray) *  | 362                  | 286             | 78.8         | 76                             | 45              | 59.2       |
| 5. Check.                                               | 358                  | 12              | 2.8          | 346                            | 0               | 0.0        |

Trial No. 2

| Treatments                                              | Total number of eggs | Eggs un-hatched | % un-hatched | Effect on newly hatched larvae |                 |            |
|---------------------------------------------------------|----------------------|-----------------|--------------|--------------------------------|-----------------|------------|
|                                                         |                      |                 |              | Total number                   | Number affected | % affected |
| 1. Ovotran, 1 lb. to 50 gals. of water (thorough spray) | 56                   | 52              | 92.9         | 4                              | 4               | 100        |
| 2. Do-, 1 lb. to 50 gals. of water (moderate spray)     | 174                  | 153             | 87.9         | 21                             | 12              | 57.1       |
| 3. Do-, 1 lb. to 100 gals. of water (thorough spray)    | 286                  | 262             | 91.6         | 24                             | 18              | 75.0       |
| 4. Do-, 1 lb. to 100 gals. of water (moderate spray)    | 196                  | 149             | 76.0         | 47                             | 20              | 42.6       |
| 5. Check                                                | 490                  | 0               | 0.0          | 490                            | 0               | 0.0        |

Trial No. 3

| Treatments                                              | Total number of eggs | Eggs un-hatched | % un-hatched | Effect on newly hatched larvae |                   |
|---------------------------------------------------------|----------------------|-----------------|--------------|--------------------------------|-------------------|
|                                                         |                      |                 |              | Total number                   | Number % affected |
| 1. Ovotran, 1 lb. to 50 gals. of water (thorough spray) | 240                  | 217             | 90.4         | 23                             | 23 100            |
| 2. Do-, 1 lb. to 50 gals. of water (moderate spray)     | 177                  | 149             | 84.2         | 28                             | 28 100            |
| 3. Do-, 1 lb. to 100 gals. of water (thorough spray)    | 148                  | 131             | 88.5         | 17                             | 17 100            |
| 4. Do-, 1 lb. to 100 gals. of water (moderate spray)    | 133                  | 80              | 60.2         | 53                             | 43 81.1           |
| 5. Check ...                                            | 61                   | 2               | 3.3          | 59                             | 0 0               |

From the above tables, it is quite clear that 'Ovotran' gives a very high percentage of kill of eggs. There appears to be little difference whether it is applied at 1 lb. to 50 gals. or 1 lb. to 100 gals. of water, so long full-coverage of the leaves is obtained. A great many of the newly hatched larvae were found dead. How this mortality was effected is yet to be ascertained.

**Table II**  
**Effect on quiescent stages**

| Treatments                                                | Total number | Number not moulted | % killed |
|-----------------------------------------------------------|--------------|--------------------|----------|
| 1. Ovotran; 1 lb. to 50 gallons of water (thorough spray) | 45           | 3                  | 6.7      |
| 2. Do-, 1 lb. to 50 gallons of water (moderate spray)     | 34           | 2                  | 5.9      |
| 3. Do-, 1 lb. to 100 gallons of water (thorough spray)    | 14           | 1                  | 7.1      |
| 4. Do-, 1 lb. to 100 gallons of water (moderate spray)    | 18           | 0                  | 0.0      |
| 5. Check ... ..                                           | 27           | 0                  | 0.0      |

'Ovotran' appears to have very little effect on the quiescent stages. This point requires confirmation.

From the trials so far carried out, it appears that 'Ovotran', as it is, will have little use in controlling Red spider on tea. To destroy the active forms, it may however be combined with another suitable acaricide which should also have



high residual action. This aspect of the problem is receiving our attention.

### **Tea Seed Bug**

Chlordane emulsion (Intox '8') was tried out against Tea Seed Bug in the laboratory but without any effect. In another trial both Aldrin and Dieldrin were found totally ineffective.

Field trials were conducted with (1) Pyrocolloid and (2) Pyrocolloid plus DDT against young nymphs of Tea Seed Bug at Tingamira Tea Seed Company. The results are as follows.

**No. 1 —** Pyrocolloid (1 lb. to 50 gals. of water) —

All nymphs were knocked down within an hour of treatment, but most of them recovered later.

**No. 2 —** Pyrocolloid plus DDT (1 lb. of Pyrocolloid and 1 lb. 50% DDT to 50 gals. of water) —

All nymphs were knocked down and almost all of them were killed.

### **Looper caterpillar**

Outbreaks of Looper caterpillar were reported from a number of gardens in Sibsagar District and in certain cases the attack was reported to be very serious. The attack by the second brood was heavy and resulted in severe loss of crop.

The methods of dealing with this pest at present consist of (1) Spraying with DDT 50% W.P. at 1 lb. to 20 gallons of water. (2) Collection and destruction of caterpillars, chrysalids and moths.

As all the moths do not emerge at a time and as egg-laying continues for about three weeks, a large number of caterpillars might pupate before the affected area is sprayed with DDT. It is therefore necessary to apply two rounds of spraying to deal with the caterpillars hatching out at different times. With the present spraying equipment available, two rounds of spray over large areas are out of question, when it is difficult to apply one round.

Application of sprays by means of mist blowing or any other existing type of power sprayer we have tested so far, does not appear to be feasible for use on tea. Until a suitable power sprayer which is capable of covering large areas in course of a few days is available, Looper caterpillar must be dealt with by adopting measures, already detailed in Tea Protection Series No. 1 and Tea Encyclopaedia Serial No. 76, paying particular attention to the control of first brood, so that the attack of second brood which is most destructive may be lessened. The first brood is usually small and very little attention is paid to it, with the consequent increase in the most destructive second brood.

Looper has a number of host plants in jungle and probably *Bormedeloa* is one of the major hosts. Deforestation appears to be one of the main factors for the enormous increase of looper population in tea gardens. Migration of looper moths from jungle into tea areas occurs very often. The Manager of the Pabhoi Tea Estate recently reported that the moths were first noticed during the early third week of May and again in the third week of July, coming in from

the North-east where there is extensive forest reserve adjacent to tea. Looper prefers Bormedeloia to tea and on several occasions it was found that Bormedeloia shade has been severely damaged by Looper caterpillar whereas the tea underneath suffered only slight damage. Bormedeloia is therefore likely to attract Looper into tea areas and replacement of this shade by others in areas where Looper has become a serious problem requires early consideration.

Gardens which do not take adequate measures against Looper caterpillar may serve as the source of attack to the neighbouring gardens.

As the Looper caterpillar pupates in the soil beneath the tea bushes, hoeing of course destroys a large number of chrysalids. The change over from hoeing to cheeling is not however considered to be a major factor in the increase of Looper populations.

Whether uncultivated tea is one of the food plants of Looper or not, is not definitely known, but it is certain that Looper has accepted cultivated tea as a major source of its food, in the plains. Cultivated tea undoubtedly provides ideal conditions for enormous multiplication of the pest supplying it with unlimited food, and sheltering it against its natural enemies.

### **Control**

A laboratory trial with two new insecticides viz., Aldrin and Dieldrin was conducted along with DDT against full-grown Looper caterpillars with the following results.

**Table 12**

| Treatments                                             | Effect on 10 full-grown caterpillars (96 hrs. after treatment) |          |                   |
|--------------------------------------------------------|----------------------------------------------------------------|----------|-------------------|
|                                                        | Dead                                                           | Inactive | Active*           |
| 1. Aldrin 50% emulsion, 1 lb. to 50 gals. of water.    | 7                                                              | 3        | 0                 |
| 2. Aldrin 50% emulsion, 1 lb. to 100 gals. of water.   | 6                                                              | 0        | 4<br>(1 pupated)  |
| 3. Aldrin 50% W. P., 1 lb. to 50 gals. of water.       | 8                                                              | 2        | 0                 |
| 4. Aldrin 50% W. P., 1 lb. to 100 gals. of water.      | 7                                                              | 0        | 3<br>(1 pupated)  |
| 5. Dieldrin 50% emulsion, 1 lb. to 50 gals. of water.  | 7                                                              | 3        | 0                 |
| 6. Dieldrin 50% emulsion, 1 lb. to 100 gals. of water. | 6                                                              | 0        | 4                 |
| 7. Dieldrin 50% W. P., 1 lb. to 50 gals. of water.     | 8                                                              | 2        | 0                 |
| 8. Dieldrin 50% W. P., 1 lb. to 100 gals. of water.    | 7                                                              | 0        | 3<br>(1 pupated)  |
| 9. DDT 50% W. P., 1 lb. to 20 gals. of water.          | 10                                                             | 0        | 0                 |
| 10. DDT 50% W. P., 1 lb. to 50 gals. of water.         | 2                                                              | 1        | 7                 |
| 11. Check                                              | 0                                                              | 0        | 10<br>(4 pupated) |

\*This includes those pupated after treatment.

Aldrin and Dieldrin at the above concentrations were less effective against full-grown Looper caterpillars than DDT at the recommended concentration (1 lb. of 50% DDT to 20 gals. of water).

DDT even at such a high concentration may not give immediate kill of all full grown caterpillars ; it may take 4 or 5 days to have the full effect and in the meantime some less affected ones might go into the soil for pupation. They are usually killed in the chrysalid stage or emerge as deformed moths. Young caterpillars are however killed within a day.

With a view to obtaining immediate knock down, field trials with pyrocolloid in combination with DDT were carried out at Duklingia T. E. Sixteen heavily infested bushes were selected for each of the following treatments, and live caterpillars found on the treated bushes were recorded after 72 hours.

**Table 13**

| Treatments                                                                                    | Number of caterpillars<br>found on the bushes<br>after 72 hrs, |
|-----------------------------------------------------------------------------------------------|----------------------------------------------------------------|
| 1. Geigy's Malariol DDT, 1 lb. to<br>20 gals. of water.                                       | 15                                                             |
| 2. Geigy's Malariol DDT, 1 lb. plus<br>$\frac{1}{2}$ lb. Pyrocolloid to 20 gals. of<br>water. | 12                                                             |
| 3. Guesarol DDT 50% 1 lb. plus<br>$\frac{1}{2}$ lb. Pyrocolloid to 20 gals of<br>water.       | 16                                                             |

**Table 13 — Contd.**

| Treatments                                                                               | Number of caterpillars<br>found on the bushes<br>after 72 hrs. |
|------------------------------------------------------------------------------------------|----------------------------------------------------------------|
| 4. Guesarol DDT 50% 1 lb. to 40<br>gals. of water,                                       | 28                                                             |
| 5. Guesarol DDT 50% 1 lb. plus 1 lb.<br>Pyrocolloid to 50 gals. of water.                | 23                                                             |
| 6. Guesarol DDT 50% 1 lb. plus<br>$\frac{1}{2}$ lb. Pyrocolloid to 50 gals. of<br>water. | 25                                                             |
| 7. Check            ...            ...                                                   | 104                                                            |

An addition of Pyrocolloid does not seem to increase the efficacy of DDT against full-grown caterpillars.

Further investigations on the ecology and habits of the pest are being made.

### **Cockchafer Grubs**

Preliminary trials were conducted with Aldrin and Dieldrin as soil treatments against 2nd and 3rd instar larvae of Cockchafer beetles in the laboratory. The results appear to be promising. Further trials are however needed.

### **Plant Louse**

Field experiments with BHC, Lime sulphur and Lime sulphur plus DDT, as prophylactic treatments against Plant louse attacking *Albizzia odoratissima* nursery plants, were conducted at Dibru-Darrang Tea Estate.



**Table No. 14**

| Treatments                 | Total plants | Healthy plants | Affected plants showing  |                |
|----------------------------|--------------|----------------|--------------------------|----------------|
|                            |              |                | Slight symptom of damage | Cabbage growth |
| 1. Lime sulphur            | 291          | 206            | 21                       | 64             |
| 2. Gammexane D·025         | 373          | 349            | 12                       | 12             |
| 3. Lime sulphur plus DDT   | 290          | 193            | 33                       | 64             |
| 4. Check      ...      ... | 348          | 182            | 53                       | 113            |

BHC (Gammexane D·025) gave very satisfactory results as prophylactic treatment. The incidence of the pest as indicated by the symptoms of damage was considerably reduced as a result of prophylactic treatment.

Another trial was conducted with Lime sulphur plus DDT at Chuapara T.E. The results were satisfactory in nursery No. 1, but hardly so in nursery No. 4.

### **Advisory**

254 specimens of fungus diseases and insect pests were examined and reported on.

501 letters and memoranda were issued in connection with diseases and pests.

44 samples of plant protection products were received for trial.

## **Publications.**

The following Tea Encyclopaedia Serials were published during the year.

1. Thread blight—Serial No. 42/1, filed under I.3. (in conjunction with Advisory Officer, Assam Valley & North Bank)
2. Key for identification of the Commoner Root Diseases of tea—Serial No. 91, filed under I.2.
3. Key for identification of the Commoner Diseases of Young tea plants in Nursery or Field—Serial No. 92, filed under I.2.
4. Scavenger Termites—Serial No. 94, filed under J.3.

## **Touring**

The Entomologist visited 2 gardens in the Dooars, 1 in Doom Dooma, 1 in Nazira, 3 in Darrang and 9 local gardens.

The Actg. Mycologist visited 4 gardens in Upper Assam, 1 in Nazira and 8 local gardens.

The Actg. Mycologist was on annual leave from 8th of December.

G. M. Das.  
*Entomologist.*  
K. C. Sarmah.  
*Actg. Mycologist.*

## PHYSICO-CHEMICAL LABORATORY

**1. Analytical and advisory work :** During the year the following samples were analysed :

|                                             |     |     |
|---------------------------------------------|-----|-----|
| Soil samples                                | ... | 533 |
| Manure samples (for experiments on gardens) | ... | 22  |
| Others                                      | ... | 24  |

The soil samples sent were in connection with routine advice about selection of nursery sites, replanting and extension areas and also existing tea areas which were not doing well. A common cause of trouble in such cases was found to be under-acidity of the soil and where necessary application of Sulphur was advised.

131 reports were issued to gardens in connection with specific problems and in addition over 300 letters were written.

**2. Touring :** A tour of gardens in the Margherita circle was undertaken in January. One garden in the Nazira circle was visited in August and local visits to gardens in the Jorhat circle where experiments are being carried out were paid as and when necessary.

**3. Publications :** Two new serials were written for the Encyclopaedia (one jointly with the plant Physiologist) and one was rewritten,

**4. Petrological analysis :** This work is held in abeyance.

**5. Soil aeration :** Attempts have been made to determine  $\text{Co}_2$  concentration in the soil air in a tea area. The Kalline plot at Tocklai was chosen for the experiment. Tubes buried at certain depths were used for drawing samples. The  $\text{Co}_2$  concentration increases rapidly with depth and with the moisture condition of the soil. There is a marked diurnal variation and considerable fluctuations occur from day to day depending mainly upon climatic changes. This particular area is well drained and the soil is sandy but even under these conditions the  $\text{Co}_2$  concentration can reach 2% at 6" depth. In areas where the soil is of a finer texture and where drainage presents difficulties inadequate aeration may well be a limiting factor for plant growth. The Plant Pathology Department have in the past suggested that in certain cases inadequate aeration of the soil may have been the cause of the debilitated condition of bushes and of certain fungal diseases. As and when an opportunity occurs an actual field problem will be investigated.

**6. Total exchange capacity and exchangeable cations :** Preliminary work on the methods and techniques to be adopted for determination of b.e.c. and exchangeable cations in the case of tea soils of N. E. India has been carried out.

**Total exchange capacity :** Three methods of extraction were tried, namely, percolation under mild suction using a Buchner funnel, simple decantation and a closed-system similar to that described by Schollenberger and Simon. The last method was found to be the best. The leaching agents tried were neutral normal solution of Ammonium acetate,

Ammonium chloride, Barium acetate and Barium hydroxide. The absorbed ammonia was found by direct distillation, after displacement by acidified 10% Sodium chloride and also using normal Potassium sulphate. Although sodium is an efficient agent for displacement of ammonia, the method of direct distillation presents no difficulties and is quicker. The higher values obtained by using Barium instead of Ammonium salts are indicative possibly of a better replacement of the exchangeable hydrogen but for simplicity and ease of working the Ammonium acetate method is preferred. The Mehlich method of using  $\text{BaCl}_2$ -triethanolamine for estimation of total exchange capacity and exchangeable cations has definite advantages over those mentioned above and this method will also be tried out, especially for determination of exchangeable hydrogen.

The following results were obtained with some of the samples examined. The first sample is from Darjeeling, the next two from the Dooars Red Bank, then two from the Dooars grey sandy loam and lastly one from Borbhetta. All samples are from areas which are under mature tea.

**Total exchange capacity m.e./100 gm. soil**

| Method                                    | Soil       |       |       |             |            |            |
|-------------------------------------------|------------|-------|-------|-------------|------------|------------|
|                                           | Nagri Farm | Sylee | Kurti | Bhar-nobari | Kumar-gram | Bor-bhetta |
| Ammonium ace-tate NaCl                    | 13.2       | 8.2   | 16.7  | 15.6        | 11.1       | 5.2        |
| Ammonium acetate and direct dis-tillation | 14.4       | 9.8   | 18.0  | 12.9        | 12.4       | ?          |
| Barium hydroxi-de Ammonium chloride       | 15.8       | 9.7   | 19.1  | ?           | 12.0       | ?          |
| Barium acetate Ammonium chloride          | 13.0       | 8.5   | 19.3  | ?           | 9.4        | ?          |
| pH                                        | 4.55       | 4.68  | 4.82  | 5.32        | 4.68       | 4.88       |
| Nitrogen                                  | 0.192      | 0.165 | 0.267 | 0.134       | 0.168      | 0.101      |

The b. e. c. of the sandy Brahmaputra alluvium ( represented by the Borbhetta sample ) is extremely low and in none of the other cases is it very high.

**Exchangeable metal cations:** The leachate after extraction with N Ammonium acetate was examined for  $\text{Ca}^{++}$ ,  $\text{Mg}^{++}$  and  $\text{K}^+$  and results for some of the soils are given below. The procedure



of Bray and Willhite for determination of total exchangeable metal cations was tried but results were not satisfactory.

| Area                  | Soil        | Exchangeable metal cation in m.e./100 gms. soil |                  |                | Total exchangeable metal bases in m.e./100 gms. soil                  |                     |                    |
|-----------------------|-------------|-------------------------------------------------|------------------|----------------|-----------------------------------------------------------------------|---------------------|--------------------|
|                       |             | Ca <sup>++</sup>                                | Mg <sup>++</sup> | K <sup>+</sup> | Summation<br>Ca <sup>++</sup><br>+Mg <sup>++</sup><br>+K <sup>+</sup> | William's<br>method | Parker's<br>method |
| Darjeeling            | Poobong     | 1.1                                             | 1.9              | 0.4            | 3.4                                                                   | ?                   | ?                  |
| "                     | Nagrifarm   | 1.0                                             | 0.8              | 1.0            | 2.8                                                                   | 4.68                | 5.77               |
| Doars Red Bank        | Hilla       | 1.4                                             | 2.0              | 0.7            | 4.1                                                                   | ?                   | ?                  |
| "                     | Sylee       | 1.3                                             | 5                | 0.7            | 4.5                                                                   | 4.72                | ?                  |
| "                     | Kurti       | 2.6                                             | 1.1              | 0.5            | 4.2                                                                   | 6.32                | 6.74               |
| Doars Grey Sandy Loam | Bharno-bari | 1.8                                             | 0.6              | 0.8            | 3.2                                                                   | 5.04                | 4.48               |
| Doars Hantupara       | Kumargram   | 3.0                                             | 1.2              | 0.2            | 4.4                                                                   | 7.40                | 4.61               |
| Jorhat                | Lankapara   | 2.0                                             | 0.7              | 0.3            | 3.0                                                                   | 5.68                | 3.13               |
|                       | Borbhetta   | 0.7                                             | 0.4              | 0.3            | 1.4                                                                   | ?                   | ?                  |

The procedures of Rice Williams for determination of the total exchangeable metal cations by leaching with N/2 Acetic acid and that following Parker using Barium acetate as the leaching agent were also tried and these results are also given in the above table for comparison.

The extreme base depletion of the Jorhat sandy soil will be noted. Figures for Dooars and Darjeeling soils although higher also show the very low base saturation of our tea soils. The saturation value in the case of our soils must be of the order of 30 to 40%.

Attempts were made to determine exchangeable hydrogen using Parker's method but without success. Further work on this using the Mehlich method is now in hand. The part that Aluminium and possibly also Iron and Manganese play in the case of our soils is not definitely known but Chenery's work has shown that Aluminium is of special importance for the tea plant. Further work on the determination of exchangeable Hydrogen and Aluminium is necessary for elucidation of the nature of acidity in the case of our tea soils.

**7. Climate :** The rainfall during the year (97.07") was well above normal, the total for the months May-October being about 14" above the normal for the period. The average temperatures during the early part of the year and the last quarter well higher than normal and so were the sunshine hours, the month of December being specially marked by exceptionally sunny days. A U. S. A. pattern standard Evaporimeter was installed in October and readings for the months of

November and December are given in table C below.

**Table A**

| 1952      | Monthly average temperatures °F |         | Hours sun-shine daily average | Rainfall ( inches ) | Wet days | Rainfall average 30 years |                 |
|-----------|---------------------------------|---------|-------------------------------|---------------------|----------|---------------------------|-----------------|
|           | maximum                         | Minimum |                               |                     |          | Inches                    | No. of wet days |
| January   | 73.82                           | 49.96   | 6.44                          | 0.83                | 4        | 0.89                      | 5               |
| February  | 78.52                           | 55.24   | 6.86                          | 0.59                | 5        | 1.34                      | 8               |
| March     | 78.14                           | 58.51   | 5.87                          | 5.34                | 15       | 3.30                      | 11              |
| April     | 85.96                           | 66.90   | 6.12                          | 6.57                | 15       | 7.79                      | 17              |
| May       | 85.56                           | 71.57   | 4.65                          | 13.10               | 20       | 10.52                     | 20              |
| June      | 90.48                           | 76.05   | 5.80                          | 12.19               | 19       | 13.02                     | 23              |
| July      | 89.97                           | 75.63   | 5.39                          | 21.77               | 27       | 15.17                     | 25              |
| August    | 89.48                           | 75.43   | 5.26                          | 14.94               | 27       | 13.21                     | 23              |
| September | 86.77                           | 74.95   | 4.63                          | 11.11               | 23       | 10.71                     | 20              |
| October   | 84.19                           | 71.57   | 4.47                          | 8.21                | 11       | 4.50                      | 12              |
| November  | 78.96                           | 62.39   | 4.94                          | 2.32                | 9        | 1.13                      | 4               |
| December  | 74.98                           | 52.49   | 7.49                          | 0.10                | 1        | 0.41                      | 3               |
| Total     |                                 |         | 67.92                         | 97.07               | 176      | 81.99                     | 171             |
| Average   | 83.07                           | 65.81   | 5.66                          |                     |          |                           |                 |

**Table B****(i) Relative Humidity (monthly averages)**

| 1952    | Jan. | Feb. | Mar. | Apr. | May | Jun. | Jul. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---------|------|------|------|------|-----|------|------|------|-------|------|------|------|
| 8 a.m.  | 95   | 91   | 89   | 85   | 89  | 89   | 91   | 93   | 93    | 94   | 94   | 95   |
| 12 noon | 65   | 58   | 66   | 64   | 77  | 75   | 79   | 79   | 78    | 80   | 76   | 69   |
| 2 p.m.  | 57   | 52   | 59   | 60   | 72  | 71   | 75   | 75   | 77    | 74   | 67   | 60   |

**(ii) Vapour Tension in inches of mercury**

(monthly averages)

| 1952    | Jan. | Feb. | Mar. | Apr. | May  | Jun. | Jul. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---------|------|------|------|------|------|------|------|------|-------|------|------|------|
| 8 a.m.  | .372 | .466 | .522 | .662 | .799 | .913 | .910 | .930 | .906  | .825 | .620 | .441 |
| 12 noon | .455 | .488 | .512 | .669 | .797 | .915 | .938 | .941 | .919  | .842 | .652 | .514 |
| 2 p.m.  | .450 | .469 | .499 | .661 | .774 | .913 | .944 | .948 | .929  | .829 | .626 | .493 |

Table C

### Soil Temperatures °F, Soil Moisture and Evaporation from a standard Evaporimeter.

| 1952      | Soil Temperature at 1 ft. |        |        |        | Soil Temperature at 3 ft. |        |        |        | Soil moisture %<br>(top 9") | Monthly Evaporation<br>inches. |
|-----------|---------------------------|--------|--------|--------|---------------------------|--------|--------|--------|-----------------------------|--------------------------------|
|           | Fallow                    |        | Grass  |        | Fallow                    |        | Grass  |        |                             |                                |
|           | 8 a.m.                    | 2 p.m. | 8 a.m. | 2 p.m. | 8 a.m.                    | 2 p.m. | 8 a.m. | 2 p.m. |                             |                                |
|           |                           |        |        |        |                           |        |        |        |                             |                                |
| January   | 65.35                     | 65.17  | 64.43  | 64.43  | 67.35                     | 67.37  | 68.69  | 68.70  | 12.61                       | ?                              |
| February  | 69.06                     | 69.18  | 69.34  | 69.14  | 70.43                     | 70.54  | 70.27  | 70.35  | 10.83                       | ?                              |
| March     | 71.26                     | 71.15  | 71.65  | 71.36  | 72.17                     | 72.25  | 72.37  | 72.38  | 12.90                       | ?                              |
| April     | 77.79                     | 78.13  | 77.80  | 77.85  | 76.07                     | 76.27  | 77.28  | 77.40  | 14.72                       | ?                              |
| May       | 81.26                     | 81.43  | 81.82  | 81.72  | 78.91                     | 79.00  | 80.99  | 81.03  | 17.89                       | ?                              |
| June      | 85.45                     | 85.36  | 86.41  | 86.22  | 82.23                     | 82.23  | 85.11  | 84.97  | 17.32                       | ?                              |
| July      | 85.85                     | 85.79  | 86.17  | 86.21  | 83.19                     | 83.20  | 85.67  | 85.69  | 18.85                       | ?                              |
| August    | 86.35                     | 86.31  | 86.95  | 86.93  | 84.22                     | 84.17  | 86.59  | 86.48  | 18.76                       | ?                              |
| September | 84.78                     | 85.19  | 85.45  | 85.90  | 83.98                     | 83.99  | 85.63  | 85.79  | 18.66                       | ?                              |
| October   | 81.86                     | 81.89  | 82.21  | 82.42  | 82.07                     | 82.22  | 82.98  | 82.87  | 17.95                       | ?                              |
| November  | 76.40                     | 76.62  | 76.74  | 76.98  | 79.75                     | 79.83  | 79.34  | 79.31  | 15.84                       | 1.805                          |
| December  | 68.71                     | 69.01  | 68.83  | 69.35  | 73.64                     | 73.78  | 72.26  | 72.35  | 13.61                       | 1.712                          |

8. The Seismograph belonging to the Meteorological Department, Govt. of India, continues to record satisfactorily.

## **Advisory Branch—Assam Valley and North Bank.**

### **I. Touring.**

During the year the Senior Advisory Officer Assam paid the following visits to gardens :

#### **ASSAM VALLEY.**

|                          |     |             |
|--------------------------|-----|-------------|
| <b>Jorhat Circle</b>     | ... | 12 gardens. |
| <b>Golaghat Circle</b>   | ... | 4 gardens.  |
| <b>Doom Dooma Circle</b> | ... | 15 gardens. |
| <b>Moran Circle</b>      | ... | 3 gardens.  |
| <b>Tingri Circle</b>     | ... | 3 gardens.  |
| <b>Panitola Circle</b>   | ... | 4 gardens.  |
| <b>Nazira Circle</b>     | ... | 2 gardens.  |
| <b>Sonari Circle</b>     | ... | 5 gardens.  |

#### **NORTH BANK.**

|                        |     |            |
|------------------------|-----|------------|
| <b>Tezpur Circle</b>   | ... | 7 gardens. |
| <b>Bishnath Circle</b> | ... | 4 gardens. |
| <b>Borsola Circle</b>  | ... | 3 gardens. |
| <b>North Lakhimpur</b> | ... | 7 gardens. |

#### **SURMA VALLEY.**

5 gardens, combined with attendance at the Annual General Meeting of the Surma Valley Branch Indian Tea Association.

#### **EAST BENGAL.**

4 gardens, combined with attendance at the Annual General Meeting of the Pakistan Tea Association.



A total of 78 gardens of which several were visited on more than one occasion. A tour was also made of South India (vide para 2).

## **2. Visit to South India.**

The Advisory Officer was deputed by the Chief Scientific Officer to attend the Annual General Meetings and Scientific Conference of the United Planters' Association of South India (UPASI) representing the Indian Tea Association, Scientific Department.

In addition to attending the Meetings and Conference visits were paid to gardens in the Nilgiris, Nilgiri Wynaad and Anamallais. Problems connected with tea cultivation and manufacture, and disease and pest control were discussed with Managers attending the meetings.

A visit was also paid to UPASI Devarshola Experimental Station and problems connected with tea research were discussed with the research staff.

The subject of the symposium at the Scientific Conference was "Problems of Weeds, Weed Control and Cover Crops on Plantations in South India". The Advisory Officer took part, and his address on "Weed Control in Tea" has been included as an Appendix to his tour report which will be ready shortly.\*

## **3. Meetings.**

The Senior Advisory Officer, Assam, attended the following Meetings :

Annual General Meeting Surma Valley Branch  
Indian Tea Association, held at Silchar.

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\*Since published as Memorandum No. 23.

Annual General Meeting Pakistan Tea Association  
held at Balisera.

In each case he addressed the meeting, representing  
the Chief Scientific Officer.

Annual General Meeting Assam Tea Planters  
Association held at Sibsagar.

Annual General Meeting Assam Branch Indian  
Tea Association held at Tezpur.

#### **4. Lectures.**

Three Lectures were given during the year :

|                |   |                                         |
|----------------|---|-----------------------------------------|
| Manufacture I  | } | To Assam Agricultural College<br>Jorhat |
| Manufacture II |   |                                         |

( Degree Course students. )

Spraying and Spraying — at the 10th Annual Con-  
Machinery in North ference of the Tocklai  
East India. Experimental Station.

#### **5. Publications.**

The following Tea Encyclopaedia Serials were  
written or rewritten and published during the  
year :

Serial 42/1 on "Thread Blight" was rewritten  
in conjunction with the Pathological Department.  
Serial 93 on "Organisation of Spraying". Serial  
10/1 on "Pruning of Young Tea (Assam kinds)"  
was rewritten in conjunction with the Agronomist,  
and Serial 97 on "Denaturing of Tea Waste" was  
written in conjunction with the Biochemist,

A Tea Encyclopaedia Serial on the subject of "Safety Precautions with Air Pressure retaining Pneumatic Knapsack Sprayers" was prepared in conjunction with the Resident Engineer and is now in the Press.\*

## 6. Memoranda.

Over 550 memoranda were issued during the year as results of visits to gardens or in answer to letters.

## 7. *Nectria* spp.

Visits were paid to the Scientific Department Jokai (Assam) Tea Company at Panitola and to Tippuk and Daisajan T. Es. with the Acting Mycologist to examine and discuss the experiments which are being carried out there on *Nectria* spp.

Two entirely different species of *Nectria* have been found prevalent in the experimental area, both of which produce conidial fructifications which are exactly similar to the naked eye.

Specimens taken to the U. K. by the Scientific Officer Jokai Company have been identified by the Commonwealth Mycological Institute as *Nectria ochroleuca*. The perithecia of this species are cream coloured. It is thought to be saprophytic and to correspond with that previously recognised at Tocklai as Kellyden *Nectria*.

A second distinct species exists whose perithecia are red which is believed to be parasitic, and has not yet been identified.

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\* Issued in January 1953 as Serial No. 98.

This subject is discussed in greater detail in the report of the Plant Pathological Department.

T. E. Serial 65 under I. 3 suggests the cutting out of *Nectria* affected wood, branch by branch to a point not less than 4" below the lowest limit of the die back.

Two alternative times for doing this are given in this Serial.

1. Cut out diseased wood as soon as the attack is noticed, so as to minimise the damage whilst *Nectria* is still actively spreading downwards.
2. If not done at this time, the cutting out can be postponed until the cold weather between November and February.

Examination of sections of tea in Daisajan Tea Estate indicates that the former alternative *is NOT to be recommended*.

The result of a cut made below the diseased area during the danger period for *Nectria* infection, is a fresh *Nectria* infection at a lower level. This is very clearly seen at Daisajan where repeated cutting out of *Nectria* between the end of December and July has resulted in a re-introduction of *Nectria* lower and lower in the frame until the final result is almost that of a collar prune.

Cutting out of *Nectria* should be done only between August and December. This, in any event, being a convenient time as cutting out can be combined with the annual prune.

## 8. The Micron Sprayer.

A number of machines of the low volume drift spraying type have appeared on the market during the last few years. The principle of all such machines is the atomisation of spray fluids into fine droplets which are ejected from an orifice at high velocity by means of a current of air from a high speed fan. The droplet mist so formed is allowed to drift with the wind over the section which it is desired to treat.

Trials at Tocklai with one machine of this type, the "Micron" Sprayer, producing a particle size of 100 microns, have shown that drift spraying is impracticable under the conditions pertaining in N. E. India, when using water-based sprays. The reason for failure is that so finely atomised a water based spray (droplet size 100 microns) evaporates completely at only a short distance (30-40 feet).

Preliminary trials showed that drift spraying with an oil based spray is practicable, and that with a light breeze, spray fluid drifted to as much as 60 yards from the machine. In Ceylon, however, it has been demonstrated by Loos (Tea Quarterly Journal of the Tea Research Institute, Ceylon Vol. 22 part IV 135-136, December 1951), that using atomised light oils, most of the oils tested, where applications were repeated, had harmful physiological effect on the tea bush causing scorch and also in many cases, tainting of the made tea.

In any event, if there is no wind and no suitable convection currents, drift spraying is out of the question.

Even assuming suitable atmospheric conditions and an oil based spray fluid which did not give rise to any taint or harmful physiological effect on the tea plant, drift spraying could only have a limited application in Assam. It is inherent in such machines, which eject an atomised fluid into the air which then drifts with the wind, gradually falling to the ground, that a top hamper cover only can be produced. The majority of pests with which we have to deal, in N. E. India, require a spray which will penetrate the top hamper of the tea bush and will adequately cover the maintenance leaf and the frame below. In the case of Black Rot, for example, a serious disease in Assam, it is essential that the under surface of the leaves also shall be covered with spray fluid.

It is felt therefore that while the Micron may have a certain number of specialised uses in restricted areas in N. E. India, it is not suitable for general use as a sprayer on tea estates. While the Micron is the only machine of this kind that we have actually tested, it is considered that these findings will be equally applicable to other machines working on the same principle.

## **9. Four Oaks Mechanised Sprayer.**

Trials were carried out with this machine, the property of the Jorehaut Tea Company at Cinnamara Tea Estate, by the Assistant Scientific Officer, Mr. N. Borbora. The Entomologist and the Acting Mycologist Tocklai Experimental Station and the Advisory Officer, Assam Valley and North Bank, were also present.



**Description :** The machine is powered by an air cooled two stroke engine. It has a ground clearance of  $5\frac{1}{2}$ ". The overall width is 12", length 20" and height 26". It is not self propelled, being pushed by a frame handle ; it is mounted on small wheels with pneumatic tyres. The weight is 80 lbs. The spray fluid is drawn from a 6-gallon tank mounted above the engine. There are four outlet taps to which rubber hoses are fitted leading to the spray lances.

Machines of this type which are designed to work from a road or path, whether stationary or mobile, from which spray fluid is fed to a number of spray lances by means of rubber hose pipes have serious disadvantages. The tea canopy seriously impedes the movement of the hoses, which break off plucking points and become entangled in the bushes, unless they can be carried on light movable trestles or can be held off the tea by boys. Neither method is entirely satisfactory and both involve additional expense and labour, particularly where the area under tea is not intersected at regular and very frequent intervals by plucking and inspection paths.

## **10. Trials with Pneumatic Knapsack Sprayers.**

At present the Pneumatic Knapsack Sprayer is the only practicable method of spraying large areas of tea, but even among Pneumatic Knapsack Sprayers there are suitable and unsuitable types.

The individually charged knapsack is uneconomic, and places too great a responsibility in the hands

of the labourer. Mechanically the part most liable to give trouble in the knapsack sprayer is the pump, and in the individually pumped models this weak point is replicated in every machine. Such machines have been found very wasteful of labour. In Ceylon it has been shown that approximately one quarter of the acreage only could be covered using individually pumped equipment as when using battery equipment, with the same amount of labour. By far the most efficient method available at the present time for spraying tea, is the air pressure retaining pneumatic Knapsack Sprayer, charged by means of a Central Charge Pump worked on the battery system. The charge pump is placed on a road or path at the boundary of a section of tea, and to it the knapsacks are returned for recharging. The charge pump being easily portable, can be moved at will, so that it is always situated conveniently for the section or sub section under treatment. One charge pump can easily maintain twelve knapsack sprayers in the field. Where a big spraying job is to be undertaken, a mechanical central charge pump is a saving in both time and overheads.

The selective weed killer trials at Bokahola T. E. afforded an opportunity to test out such equipment. The most satisfactory system of this type which was tested was the Favori-Colibri sprayers and pump supplied by Messrs. Cooper Pegler & Co., Ltd., Calcutta Agents: Messrs. McLeod & Co., Ltd.

Later in the year, prototypes of the new Holder-Harriden "All-Purpose" Pneumatic Knapsack

Sprayer charged by means of the "Salta" Central Charge Pump manufactured in Calcutta, were examined and tested at Tocklai. The Agents for this machine are Messrs. Shaw Wallace & Co., Ltd., These trials suggested that this spraying system should be well suited to the needs of the tea industry, and these sprayers are now available.

## **II. Low Volume Spraying.**

Low Volume spraying holds great promise—it is still in its infancy in North East India; it has been in use against Blister Blight with excellent results, for a little over a year, in Ceylon. It involves only the use of special nozzles or jets, interchangeable with the normal high volume nozzles supplied with knapsack sprayers. This type of nozzle produces an extremely finely divided fanshaped spray enabling an even cover to be obtained with something like one quarter the fluid which would be required when using high volume nozzles. Trials with low volume nozzles are in progress at Tocklai, and the indications are that low volume spraying is likely to be of the greatest importance to the Tea Industry in the control of many pests and diseases met with on tea gardens, resulting in satisfactory control with, at the same time, considerable saving in labour, chemicals and fluid.

The most satisfactory low volume nozzle tested was the FAN-JET C 60 whose output is approximately 1/12 gallon per minute. This low volume nozzle is fitted as standard equipment to

the Holder-Harriden "All-Purpose" Pneumatic Sprayer.

## 12. Selective Weed Killers.

A trial was laid out at Bokahola T. E. in a thatch bari with the following Selective Weed Killers supplied by Messrs. Imperial Chemical Industries (India) Limited :

Fernoxone at  $2\frac{1}{2}$  lbs. per acre.

Chloroxone at  $2\frac{1}{2}$  lbs. per acre.

Agroxone at 0.275 gallons per acre.

2 4 5-T at 0.4 gallons per acre.

Each material was used at both high and low volume, and plots were of  $\frac{1}{4}$  acre size. With check, this involved 9 treatments and 4 replicates. Spraying was carried out on the 25th-28th March inclusive.

Using high volume nozzles, 130 gallons of liquid were required to cover an acre. With low volume nozzles (FAN-JET C 60) adequate coverage was obtained with 24 gallons and there were indications that a much lower figure would be practicable. Low volume spraying effects a considerable saving in time and labour.

Preliminary results suggest that Agroxone is of little value. Fernoxone and Chloroxone were both fairly effective; though Chloroxone gave better results at high volume than at low. This is believed to be due to this material being extremely difficult to dissolve in water with consequent easier solution in larger volumes of

liquid, together with less sedimentation. 245-T, however, proved by far the most successful treatment especially against more woody types of weeds, both at high and low volume.

### 13. Manuring Experiments.

The following manuring experiments are in progress :

1. Manuring on Bheel Soils ... Bhubandhar T. E.
2. Sulphate of ammonia and ... Jamirah T. E.  
Oilcake.
3. Sulphate of ammonia and ... Halem T. E.  
Cattle manure
4. Shade-Nitrogen and ... Hunwal T. E.  
Plucking Moortee T. E.  
Baradighi T. E.  
Rydak T. E.
5. N. P. K. Experiment ... Bindukuri T. E.  
Moortee T. E.  
Rydak T. E.
6. Shade and Manuring ... Eight gardens on  
the North Bank.

( P. M. Glover )

*Senior Advisory Officer, Assam.*

## **ADVISORY BRANCH, WEST BENGAL**

### **I. Administration.**

The Advisory Officer, Darjeeling and Terai returned from leave in May. and after a short period at Tocklai proceeded to reopen the office of the Advisory Officer, Darjeeling and Terai, in the Darjeeling District.

In the meantime the headquarters had been transferred to Patabong T. E. from Kurseong which was eventually occupied at the beginning of August.

Towards the end of the year the Dooars was officially added to the jurisdiction of the Advisory Officer in pursuance of the policy of eventually forming a West Bengal Advisory Department with Headquarters in the Dooars, while still retaining an Advisory Officer in the Darjeeling area.

### **2. General.**

The season was coloured by the sudden collapse of the tea market. While the slump has hit the Terai and Dooars extremely hard, conditions in Darjeeling were such that at the end of the year a number of Gardens were threatened with closure. Temporary relief measures introduced at the close of the year have prevented immediate closure, but a number of gardens are still in a precarious position, and their continuance in business is only being effected by drastic economies which are not, in many cases, to the best advantage in respect of cultural treatment of tea.



Perhaps the most dangerous economy is that concerned with a considerable reduction in the level, if not complete cessation of manuring.

During the season there was a very definite trend towards finer plucking with the object of improving quality in both Darjeeling and the Plains Districts. This has had its obvious repercussions on yields and as a corollary thereto production costs per pound.

The season was average, but in the Dooars, floods of an abnormal nature not only completely dislocated traffic for a considerable period, but in certain areas damaged considerable areas of tea.

### 3. Experiments.

No new experiments were initiated in Gardens during the year. Observation plots for the study of "Banjhi", and also on recovery from medium pruning were however initiated at Pattabong.

Preliminary experiments on grading of seed (collected locally from tea in bearing) *vis a vis* the kind of tea they produce, and also on seed storage were also initiated to the extent existing facilities provided. These experiments and others of a fundamental nature will be extended as opportunity offers.

Data on pruning experiments at Mim, and Tumsong and on manuring experiments at Margaret's Hope were received at the end of the year and will be analysed in due course.

#### 4. Pathological.

##### I. *Exobasidium vexans*. (Blister Blight.)

In the Darjeeling District this disease took a normal course. It became evident in some considerable degree of incidence as usual towards the end of June to the beginning of July, and achieved epidemic proportions in August and September and continued till the end of the year.

In the Plains, in the Terai, an Estate bordering the Foothills reported considerable incidence, and in the Dooars Blister was observed in October and was continuing at the end of the year.

In the Plains young tea is particularly susceptible towards the end of the season, though mature tea also carries the disease in many localities.

A report of some damage to young tea pruned in November was received; this again draws attention to the dangers inherent in the District of undertaking pruning early enough to permit regrowth in the current season when Blister Blight is present.

##### II. *Aglaospora aculeata*. (Thorny stem Blight.)

An instance of where this disease had caused considerable damage in the Darjeeling District has been previously reported on. This year another Garden has been found severely affected.

As before, casualties exhibited themselves after a cyclic prune, bushes failing either completely, or only partially to recover. Specimens sent to Tocklai

verified the diagnosis that the disease had extended to the collar region of the plant in which case it is usually fatal.

The disease is normally considered a disability one, and the occurrence on yet another Estate draws attention to the fact that much of our tea is well beyond its economic rotation and progressive debility in the course of time must be expected. The question arises whether cessation of manuring will not further increase the danger of infection by this disease on all ready outworn tea.

### III. *Fomes lamaoensis*. (Brown Root Rot.)

Considerable incidence of this primary root disease is found in many parts of the Dooars. Attention was drawn to this by the Acting Mycologist after a tour in the Eastern Dooars, but the disease appears to be wide-spread and deserves considerably more attention than that which it is at present receiving in Estate practice.

A request was received from an Estate in the Central Dooars for a visit by the Advisory Officer in connection with this particular disease, wherein it was stated a very high number of casualties had occurred and the disease was still spreading.

### IV. *Hypoxylon asarcodes*.

This primary root disease appears to occur mainly in the foothill areas of the Terai and Dooars, and is responsible for a considerable number of casualties. It also attacks shade trees, dead stumps of which appear to be the main source of spread of the infection.

Symptoms of attack are very similar to those of other root diseases like *Ustilina Zonata* (Charcoal stump rot) in that the bush collapses suddenly towards the end of the rains. Encrustations on the stump are also not unlike those of Charcoal stump rot, but can be distinguished therefrom by their smoother surface and their dark olive green colour.

#### V. *Helopeltis theivora*. (Tea Mosquito.)

Tea mosquito appeared as usual towards the end of the season in the Darjeeling District at normal degree of incidence.

In a foothills Estate of the Terai, an attack at a high degree of incidence was reported at the end of the season. In the Kalchini District of the Dooars a recrudescence of mosquito in epidemic proportions occurred, after a long period of almost complete absence.

#### VI. *Unidentified Capsid*.

In a high elevation estate in the Darjeeling District symptoms very similar to those of *Helopeltis theivora* were observed on tea from July onwards. Detailed examination showed this to be due to another Capsid however, identification of which is awaited.

Observations in the field showed this particular bug to be much more active in flight than *Helopeltis*, but on laboratory scale experiments to be highly susceptible to D. D. T. It is therefore opined that recommended control treatment as for *Helopeltis* will apply.

### VII. *Tetranychus bioculatus*. (Red Spider.)

During the year many areas of Darjeeling were particularly badly hit by Red Spider, which achieved a degree of incidence stated to be higher than ever experienced before. Evidence of its presence in considerable quantity was found as late as the beginning of July in some areas, but to a great extent lifted with the advent of the full force of the Monsoon.

### VIII. *Thripidae*. (Thrips.)

Thrips made their presence felt as usual in the Darjeeling District at the beginning of the season but had lifted by the time the Advisory Officer returned to Darjeeling.

Observations in the field towards the end of the year have shown a very heavy infestation of a species of Thrip (black) in tea flowers, both in the Darjeeling District and in the Plains. Periodic collections were made and will be continued for identification purposes in order to establish whether the species found in flowers is that which causes damage in the Spring.

### IX. *Psyllidae* in *Aodoratissim* nurseries. (Plant lice.)

This insect continues to cause considerable trouble in Aodoratissima nurseries throughout the Plains but it would appear from trials conducted under the *aegis* of Tocklai that some considerable measure of control can be effected by spraying or dusting with Gammexane or spraying with a mixture of D. D. T. and lime sulphur. It is understood a T. E. Serial will shortly be issued on this subject.

## 5. Vegetative Propagation.

The technique of vegetative propagation continues to be actively pursued by certain groups in the Darjeeling District and some considerable advance has been made in connection with establishment of clones for continuance of field trials.

In the Darjeeling District this has reached a critical stage in the light of the special requirements of Darjeeling Teas, in particular flavour, and it is hoped that in the coming season material will be available from nucleus clones in sufficient quantity to manufacture adequate samples for tasting and blending purposes.

In the Kalchini District, Eastern Dooars, considerable complications have arisen in relation to the striking of internode cuttings. Those put down both from Tocklai releases and from locally selected material during April and May, and September and October have developed excessive callus formation at the expense of adequate rooting. It is more than possible that this is due to the high rainfall which occurs in the area and the excessive moistness of the beds thereby, and trials are kindly being undertaken in certain Estates to establish whether modification of technique will remedy this defect.

Trials on the taking of cuttings have been initiated at Puttabong to test standard technique at an elevation of some 5,800 feet, and on a Northerly aspect.

It may be of interest as a preliminary note that cuttings set down in the middle and end of



September had by the end of December shown no root formation and casualties were high. With the limited facilities available however at that time in respect of site for nurseries as a result of comparatively recent occupation of the headquarters, the cuttings were perforce put down under somewhat adverse conditions. Trials will be continued.

## **6. Manufacture.**

Leaf from predominantly "China hybrid" and "Assam hybrid" kinds of tea were manufactured separately on a miniature scale in an attempt to establish whether typical Darjeeling characters and in particular flavour are confined to the former or not.

Rolling was by hand and firing by home made electrical equipment and as such the made teas leave a lot to be desired. The Tea Taster Tocklai however reported that the standard of manufacture was good enough to make comparisons.

The number of trials conducted were very limited as work thereon was started only late in the season, and are inconclusive. It is hoped that equipment for miniature manufacture on a more reasonable scale will be made available at Puttabong for such and other trials.

## **7. Botanical.**

At the request of the Botanist, Tocklai, a survey of stigma formation in Tea flowers was made in the Puttabong area.

## **8. Visits.**

Mr. J. M. Trinick, the Tocklai Tea Taster visited Darjeeling in June 1952 and tasted a number of individual bush manufacture samples in connection with selection for vegetative propagation.

## **9. Tours.**

The Advisory Officer visited a number of Gardens in the Dooars and Darjeeling and attended the tenth Annual Scientific Conference at Tocklai in December.

## **ENGINEERING DEPARTMENT.**

During the period under review the most important items of work have been in connection with the following :—

- (i) Renovation of existing Direct Current electric supply system.
- (ii) Construction of Engineering Research Workshop and A. C. Generator Power House.
- (iii) Erection of Experimental Withering Chamber.
- (iv) Erection of 55 K. W. 400-440 volt 3-phase 50 cycle McLaren/Brush Generator Set, together with feeder cables to overhead distribution lines.

### **(i) Tocklai Station Electric Supply.**

All overhead distribution lines, where necessary, have been re-strung with conductors which result in a nominal voltage drop consistent with maintaining expenditure within reasonable limits.

Switch and Distribution boards in the Power House have been constructed in accordance with load requirements. Cabling to all existing motors in the experimental tea factory has been renewed. Distribution and isolation switches for these circuits have been incorporated on the same Switch board as the circuit in connection with the Experimental Withering Machine which is also housed in the factory building.

### **(ii) Engineering Research Workshop and Power House.**

It was found convenient to combine the Workshop and A. C. Generator Plant in the same building with a dividing wall separating the two.

The building measures 70 feet in length, 30 foot span and 14'—6" to eaves level. It is constructed of R. C. pillars at 8'—6" centres which support suitable angle iron roof trusses. Roof covering is Asbestos Cement Sheets. Walls are constructed of concrete hollow blocks and the floor is cement concrete.

Machine tools, comprising the following, are located in this building :—

- One—Lathe having 12'—0" length of bed.
- One—Vertical Drilling machine.
- One—Plate and Angle Shearing machine.
- One—Power driven hacksawing machine.
- One—Wet and Dry Stone Grinder.
- One—24" stroke Shaping machine (not yet to hand).

The Drawing and Clerk's Office are enclosures within the Workshop section of the building.

Due to much delay in transit of materials between Calcutta and Neamati Ghat it has not been possible to put the Workshop or A. C. Generator into commission. Receipt of Line shaft pulleys and Distribution Board materials constitute the main delay.

### (iii) **Experimental Withering Machine.**

After repeated delays in receipt of various items this machine was finally completed during the month of October but unfortunately too late to fulfill a useful purpose during the Plucking Season.

Receipt of a small quantity of pipe lagging material is awaited before full scale tests are concluded which, according to the Maker's specification is as follows :—

- (a) Air speed—range 50 to 300 feet per minute.
- (b) Dry bulb temperature—range 70° to 100°F.
- (c) Relative humidity—range 50% to 95%.

All components, relays etc. have been tested and found to react in a satisfactory manner.

### **Erection of 55 K. W. A. C. Generating Set.**

This set has been installed but not yet commissioned on account of non-receipt of Distribution Board and Bus-bar Chamber material on order from Calcutta. As mentioned previously, the Generator Set is McLaren/Brush manufacture of 55 K. W. capacity at 400/440 volt 3 phase 50 cycles and is equipped for automatic voltage regulation as well as for manual control. It is also suitable for parallel operation should this be necessary in future.

### **General.**

The first stage in the construction of two plinth type Bungalows has been started which entails dismantling of the "Bara" Bungalow, the site of which will be utilised for the new buildings. Materials dismantled from this old building will, as far as possible, be utilised in the new construction with particular reference to structural steelwork.

*Resident Engineer.*

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